Vector-Borne Diseases in California

2003 Annual Report

Vector-Borne Disease Section
California Department of Health Services
August 2004

2003

ANNUAL REPORT

VECTOR-BORNE DISEASE SECTION

INFECTIOUS DISEASES BRANCH

DIVISION OF COMMUNICABLE DISEASE CONTROL

CALIFORNIA DEPARTMENT OF HEALTH SERVICES

Arnold Schwarzenegger
Governor
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Kimberly Belshé, Secretary
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2003

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VECTOR-BORNE DISEASE SECTION

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State of Calfiornia-Health and Human Services Agency

Department of Health Services

California Department of Health Services

SANDRA SHEWRY
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Governor

I am pleased to submit to you the 2003 Annual Report for the Vector-Borne Disease Section (VBDS) of the California Department of Health Services (CDHS). VBDS staff conducted surveillance, prevention, and control of existing and emerging vector-borne diseases throughout California in 2003. Our biologists investigated five human cases of hantavirus pulmonary syndrome and conducted numerous plague surveys at recreational areas in California. Staff devised strategies to better assess and reduce risk of exposure to tick-borne relapsing fever and collaborated with local agencies on the first longitudinal study of the ecology of *Borrelia burgdorferi*, the causative agent of Lyme disease, in southern California. We developed new tick-borne disease educational materials and conducted a survey of California physicians to assess their awareness of Lyme disease and other tick-borne diseases.

In 2003, West Nile virus (WNV) was found in 46 states. Almost 10,000 human cases of WNV were detected, including 262 deaths, constituting the largest epidemic of arboviral meningoencephalitis documented in the Western Hemisphere. In California in 2003, our statewide arbovirus surveillance program detected three locally acquired human WNV cases, and WNV infection in dead birds, mosquitoes, sentinel chickens, and a horse in six southern California counties. In response to the initial detection of WNV, CDHS and collaborating local and state agencies intensified surveillance and response efforts. VBDS developed an operational plan for emergency response to WNV outbreaks and included this and other publications on the expanded website: www.westnile.ca.gov. CDHS enhanced public awareness by holding press conferences, issuing news releases, and developing educational materials. Through this statewide effort to detect and respond to the introduction, spread, and establishment of WNV in California, we have developed many valuable partnerships with other departments and agencies.

VBDS completed the fourth year of a project to evaluate mosquito production in stormwater treatment devices. In 2003, VBDS staff expanded the focus of this project from southern California to the Lake Tahoe Basin where water quality standards are among the most stringent in the state.

Many of you are our collaborators and colleagues and I hope that you find the information contained in this annual report to be of value as we collectively strive to promote and protect the health of all Californians.

Respectfully,

Vicki L. Kramer

Vicki L. Kramer, Ph.D., Chief
Vector-Borne Disease Section

Introduction

The mission of the California Department of Health Services Vector-Borne Disease Section (VBDS) is to protect the health and well-being of Californians from insect and animal transmitted diseases and injurious pests. VBDS provides leadership, information, and consultation on vector-borne diseases to the general public and agencies engaged in vector control activities.

VBDS staff, located in seven regional offices and headquartered in Sacramento, provide the following services:

- Develop and implement statewide vector-borne disease surveillance, prevention, and control programs
- Design and conduct scientific investigations to further knowledge of vector-borne diseases in California
- Coordinate preparedness activities for detection and response to introduced vectors and vector-borne diseases, such as West Nile virus
- Conduct emergency vector control when disease outbreaks occur
- Administer public health exemptions where applicable under the Endangered Species Act in disease outbreaks
- Advise local agencies on public health issues related to vector-borne diseases
- Oversee local vector control agency activities through a Cooperative Agreement
- Oversee the Vector Control Technician Certification and Continuing Education programs
- Provide information, training, and educational materials to governmental agencies and the public
- Provide assistance in coordinating issues related to the management of Africanized honey bees and red imported fire ants
- Advise local governmental agencies, schools, and the public on head lice management
- Maintain the San Francisco Bay Area U.S. Army Corps of Engineers general permit, which allows local vector control agencies to conduct abatement activities
- Oversee Special Local Need permits on restricted use of public health pesticides

This report summarizes surveillance and control activities for plague, hantavirus pulmonary syndrome, and mosquito- and tick-borne diseases in 2003. Activities conducted in the National Forests of California to protect United States Forest Service (USFS) personnel and visitors from vector-borne diseases are included in this report; USFS provides support for these activities through a cost-share agreement. Results from a special project with the California Department of Transportation to examine vector production in stormwater treatment devices are described. VBDS oversees the Vector Control Technician Certification Program; data summarizing the number of exams administered by VBDS and the number of vector control technicians in each certification category are provided. As education and training are important components of a vector-borne disease prevention program, a summary of the many presentations and reports prepared by VBDS staff is included. Many of the state and local agencies with which VBDS collaborated in 2003 are listed in the Acknowledgments section.

Authorizing statutes include: Health and Safety (H&S) Code 116108-116120; H&S Code 116102, et. seq.; H&S Code 116180; Gov. Code 12582

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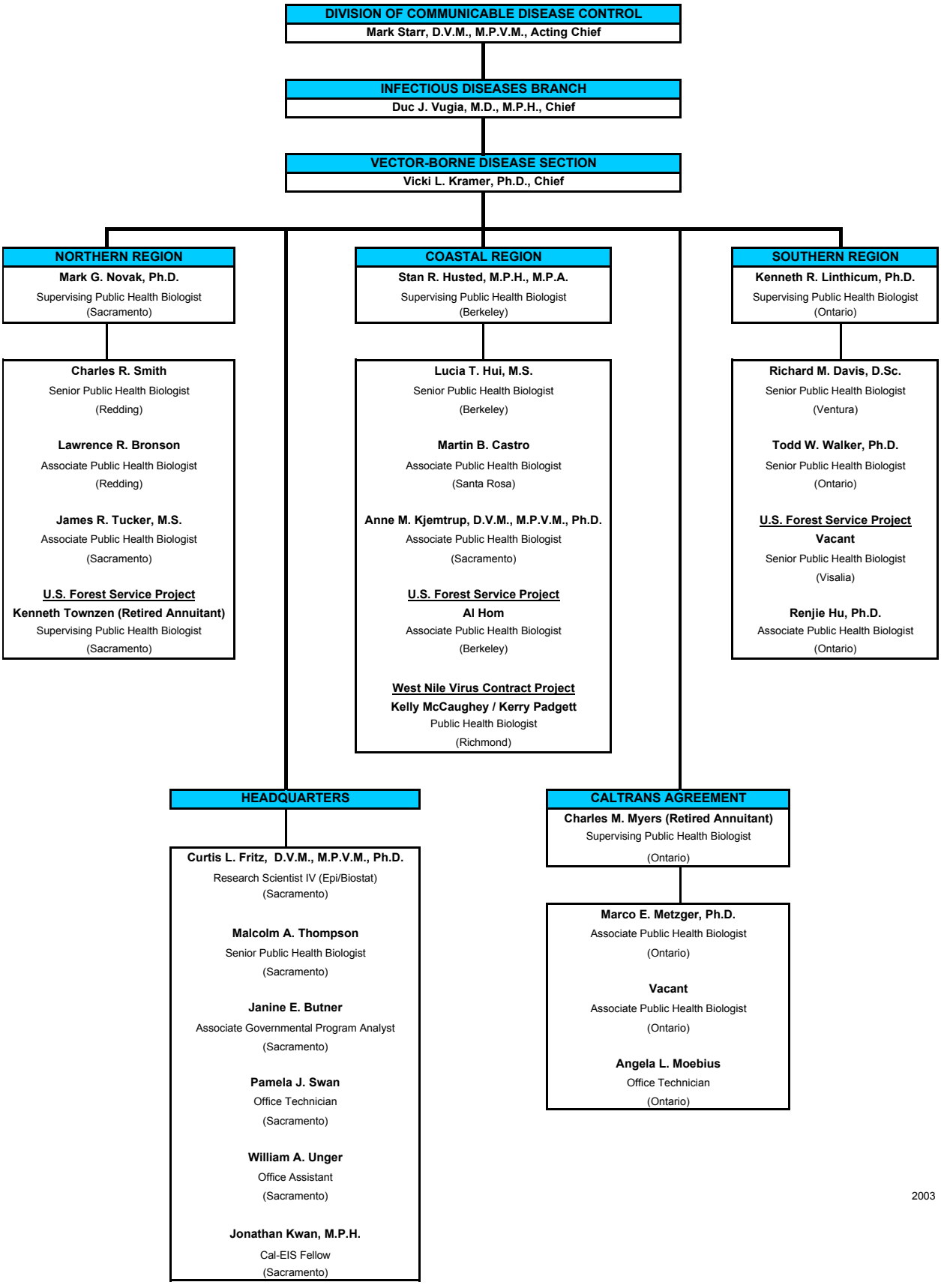
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Rodent-borne Virus Surveillance

Hantavirus pulmonary syndrome in California residents
Five cases of hantavirus pulmonary syndrome (HPS) were identified in California residents during 2003. Investigations of these cases by the California Department of Health Services (CDHS) and collaborating agencies are summarized below.

Inyo County, July 2003
A 20-year-old male resident of Inyo County presented to a local hospital in late July with approximately four days of fever, headache, and myalgia. The patient developed respiratory difficulty following hospitalization. Thoracic radiographs revealed bilateral interstitial infiltrates. The patient was transferred to a metropolitan hospital on Day 2 of hospitalization. His respiratory condition stabilized and he was maintained on supplementary oxygen. The patient recovered and was discharged home on Day 7. Serum collected at the metropolitan hospital and sent to a commercial laboratory was reported as "positive" for hantavirus antibody. The CDHS Viral and Rickettsial Disease Laboratory (VRDL) and the Special Pathogens Branch of the Centers for Disease Control and Prevention (CDC) confirmed the presence of immunoglobulin (Ig) M antibody to Sin Nombre virus (SNV) in serum collected on Day 2.

Staff of the Inyo County Departments of Health and Environmental Health, with assistance from CDHS Vector-Borne Disease Section (VBDS), conducted an investigation into the circumstances of the case-patient's exposure. The case-patient traveled to Wyoming immediately prior to onset but reported no rodent contact. Rodent surveillance was conducted at the patient's residence; 100 traps placed around the property yielded four deer mice (*Peromyscus maniculatus*) and one piñon mouse (*P. truei*). Antibodies to hantavirus were detected in three of the deer mice. Inyo County health officials prepared and distributed educational materials on the prevention of HPS to community residents and representatives.

Santa Barbara County, July 2003
A 74-year-old male resident of Santa Barbara County presented to a local hospital in mid July following a single syncopal episode. The patient was treated for mild hypotension and released. Four days later, the patient presented again with complaints of additional syncopal episodes, as well as abdominal pain and mild diarrhea. Thoracic radiographs at admission revealed a patchy diffuse infiltrate. The patient was hospitalized and developed progressive respiratory difficulties later that same day. The patient died within 24 hours of hospitalization. In late October the CDC Special Pathogens Branch reported detecting hantavirus by immunohistochemistry in kidney and lung tissue.

The patient's family reported that he had camped in a mobile home in the eastern Sierra Nevada for four weeks prior to onset of illness. They reported having trapped mice in the garage of the Santa Barbara County residence after returning from similar trips to the Sierra in previous years. Three mice were reported trapped at the patient's residence approximately two months after his illness and death. The Santa Barbara County Health Department and VBDS conducted a site evaluation of the patient's residence in November. No current evidence of rodent activity was observed in or around the patient's residence. The onset of winter snows precluded comprehensive rodent surveillance at the RV park in Inyo County. However, rodent surveillance previously conducted in association with other HPS cases documented evidence of deer mice and hantavirus in the area. Inyo County health officials provided information on hantavirus to the park concessionaire and offered recommendations for ongoing rodent control.

Sierra County, October 2003

In late October, a 42-year-old female resident of Sierra County was admitted to a Tahoe area hospital with a three-day history of high fever and fatigue. The patient developed severe respiratory distress and was intubated and placed on a ventilator for three days. The patient recovered rapidly following extubation and was discharged one week after admission. The Nevada State Public Health Laboratory reported detecting both IgM and IgG antibodies to hantavirus in acute serum. TriCore Laboratories, New Mexico, confirmed the presence of hantavirus antibody in convalescent serum.

The patient reported noting considerable dust and rodent droppings while moving boxes in an outbuilding on her property several days before onset of illness. The patient worked at several different sites, but reported no recent travel outside Sierra County. Staff of the Sierra County Environmental Health Department and VBDS conducted evaluations and rodent surveillance at the patient's residence and work sites. Nine *P. maniculatus* were collected over approximately 160 trap-nights around the patient's residence; no evidence of rodents was noted at her work sites. Antibodies to SNV were detected in two mice. Both mice were collected on a hillside approximately 30-60 meters behind the case-patient's residence.

Alpine County, October 2003

A 43-year-old male resident of Alpine County presented to a local emergency clinic in early November with a four-day history of fever, chills, and myalgia and one day of cough and pharyngitis. Significant findings on physical exam and laboratory evaluation included mild hypotension, tachycardia, and thrombocytopenia. Thoracic radiographs revealed mild pulmonary edema. The patient was transferred to a regional hospital for further workup and management. The patient recovered fully following respiratory support and was discharged after ten days of hospitalization. A commercial laboratory reported detecting IgM and IgG antibody to hantavirus in acute serum. The VRDL confirmed the presence of IgM antibody to hantavirus (IgG was regarded as equivocal) in an aliquot of the same specimen.

The patient reported observing rodents and their droppings in his residence prior to illness. He reported trapping and disposing of, without gloves or other protection, two to three mice each month in his home. The patient worked as a heavy equipment operator at a nearby ranch where he reported also observing rodents and droppings. He had no history of travel outside his home and work sites prior to illness. The Alpine County Health and Human Services, the State of Nevada Department of Human Resources, and VBDS conducted site evaluations and rodent surveillance at the case-patient's residence and work sites in December. Rodent droppings were noted in the kitchen and laundry rooms of the residence. Potential rodent access points were identified in gaps around pipes and electrical wiring in the laundry room. Rodent droppings were also noted in the garage. One hundred live traps were placed overnight in and around the house and other buildings. Twenty *P. maniculatus* were collected; antibody to SNV was detected in serum from one mouse. Inspection was conducted and 25 traps set at a site where the case-patient had participated in demolishing several buildings. Five *P. maniculatus* were collected and SNV antibody was detected in serum from one. Evaluation of other sites where the patient worked suggested unlikely opportunity for contact with rodents and their excreta. Recommendations were made to conduct rodent exclusion and ongoing monitoring at the residence, and to include hantavirus information in the safety training provided to ranch employees.

San Bernardino County, October 2003

A 42-year-old male resident of San Bernardino County presented to a local hospital in late October with a one week history of fever, headache, and chills and one day of shortness of breath. At presentation the patient was noted to be thrombocytopenic and thoracic radiographs revealed bilateral infiltrates. The patient was hospitalized but did not require respiratory support. He recovered and was discharged five days after admission. A commercial laboratory reported detecting IgM and IgG antibodies to hantavirus in acute serum. VRDL confirmed the presence of IgM and IgG antibodies to hantavirus in an aliquot of the acute specimen.

Other than pet guinea pigs, the patient denied contact with rodents. He reported cleaning up "rat droppings" in his garage several times in the weeks preceding his illness. The patient's only reported travel during the weeks prior to onset was a business trip to the Tahoe area. As part of his job, the patient reported visiting many buildings in the week's preceding his illness but reported no activities likely to place him at risk for exposure to hantavirus. The San Bernardino County Health Department and Vector Control Program and VBDS conducted a site evaluation of the case-patient's residence in January 2004. A small amount of rodent droppings was observed in the garage; however, 40 traps set in the garage and surrounding area failed to capture any mice.

Since 1993, HPS has been diagnosed in 40 California residents. Four of these were identified retrospectively, with onset of illness having occurred in 1980, 1984, and 1992 (2). An additional two California residents were diagnosed with acute SNV infection without pulmonary manifestations. The median age of all 42 case-patients was 42 years (range, 12 to 74) and 24 were male. Case-patients were residents of 18 counties—Alameda, Alpine, Contra Costa (2), Inyo (6), Kern (4), Los Angeles (2), Modoc, Mono (9), Nevada (2), Plumas, Sacramento, Santa Barbara (2), San Bernardino, San Francisco, Santa Clara (2), Sierra, Ventura (2), and Yolo (2). Probable and possible sites of exposure included the counties of Alameda, Alpine (2), Fresno, Inyo (7), Kern (4), Modoc, Mono (11), Nevada (2), Placer, Plumas, San Bernardino, Santa Barbara, Sierra, and Tuolumne, and the states of Arizona, New Mexico (3), Utah, and Washington. Fifteen (36%) cases had a fatal outcome.

Surveillance for hantavirus in California rodents

Surveillance for hantavirus in rodents was conducted in 15 California counties during 2003. A total of 2,378 small mammals was collected and serologically tested for SNV antibody, representing at least 25 species from 12 genera (Table 1). At least one seroreactive rodent was detected in 11 California counties and 1 Nevada county. Of 1,800 *Peromyscus* spp. collected, 197 (10.9 %) had serologic evidence of infection with SNV. Seroprevalence was highest in *P. maniculatus* at 16.4 percent. Active surveillance since 1993 and retrospective analysis of rodent specimens captured since 1975 have identified serologic evidence of SNV infection in 12.6 percent of *P. maniculatus* statewide. At least one seroreactive *P. maniculatus* specimen has been identified in 44 of 54 counties sampled (Table 2). *Reithrodontomys megalotis* and *Microtus californicus* specimens have demonstrated evidence of infection with Sin Nombre-like hantaviruses (El Moro Canyon and Isla Vista, respectively), but these strain variants have not been shown to be pathogenic to humans. Seroreactivity has been occasionally identified in *Neotoma*, *Chaetodipus*, and *Spermophilus* rodents in California and elsewhere; however, it is believed that these species are incidentally infected with SNV and are not competent reservoirs or vectors.

Table 1. Serologic evidence of hantavirus (Sin Nombre) in California rodents, 1975-2003.

		2003			1975-2003		
Species	Common name	No. collected	No. reactive	Percent	No. collected	No. reactive	Percent
FAMILY MURIDAE							
SUBFAMILY SIGMODONTINAE (New World mice and rats)							
Neotoma fuscipes	dusky-footed woodrat	67	2	3.0	859	10	1.2
Neotoma lepida	desert woodrat	180	9	5.0	603	21	3.5
Neotoma sp.	other and unspecified *Neotoma*	47	0		121	2	1.7
Onychomys torridus	southern grasshopper mouse	1	0		5	0	
Peromyscus boylii	brush mouse	242	5	2.1	1612	67	4.2
Peromyscus californicus	parasitic mouse	136	6	4.4	1761	35	2.0
Peromyscus crinitus	canyon mouse	92	5	5.4	276	11	4.0
Peromyscus eremicus	cactus mouse	318	24	7.5	1166	55	4.7
Peromyscus maniculatus	deer mouse	933	153	16.4	7251	917	12.6
Peromyscus truei	piñon mouse	27	1	3.7	634	23	3.6
Peromyscus sp.	unspecified *Peromyscus*	52	3	5.8	156	15	9.6
Reithrodontomys megalotis	western harvest mouse	69	8	11.6	579	71	12.3
Sigmodon hispidus	hispid cotton rat	0			22	0	0.0
SUBFAMILY ARVICOLINAE (voles)							
Clethrionomys californicus	California red-backed vole	0			1	0	
Microtus californicus	California vole	16	2	12.5	176	31	17.6
Microtus spp.	other and unspecified *Microtus*	13	0		49	5	10.2
SUBFAMILY MURINAE (Old World mice and rats)							
Mus musculus	house mouse	37	0		293	0	
Rattus spp.	Norway rat & black rat	20	0		188	0	
FAMILY HETEROMYIDAE							
Chaetodipus spp.	pocket mice	120	0		570	3	0.5
Dipodomys spp.	kangaroo rat	1	0		77	1	1.3
Perognathus parvus	Great Basin pocket mouse	5	0		33	1	3.0
FAMILY SCIURIDAE (squirrels and chipmunks)							
Ammospermophilus leucurus	white-tailed antelope squirrel	0			5	0	
Glaucomys sabrinus	northern flying squirrel	0			1	0	
Sciurus griseus	western gray squirrel	0			1	0	
Spermophilus spp.	ground squirrels	0			1227	1	0.1
Tamias spp.	chipmunks	1	0		285	0	
Tamiasciurus douglasii	Douglas's squirrel	0			8	0	

Source: California Department of Health Services

Table 2. Serologic evidence of hantavirus (Sin Nombre) infection in *Peromyscus maniculatus*, by county, 1975-2003.

	2003			1975-2003		
County	**No. collected**	**No. reactive**	**Percent**	**No. collected**	**No. reactive**	**Percent**
Alameda	25	0		92	2	2.2
Alpine	20	1	5.0	102	32	31.4
Butte				115	14	12.2
Calaveras				45	9	20.0
Colusa				23	9	39.1
Contra Costa				36	0	0.0
Del Norte				49	1	2.0
El Dorado	94	45	47.9	221	106	48.0
Fresno				508	75	14.8
Glenn				4	0	0.0
Humboldt				55	5	9.1
Imperial				6	1	16.7
Inyo	4	3	75.0	81	8	9.9
Kern				129	10	7.8
Lake				22	1	4.5
Lassen	136	19	14.0	317	58	18.3
Los Angeles	1	0		397	22	5.5
Madera				62	8	12.9
Marin				105	3	2.9
Mariposa				46	7	15.2
Mendocino				38	4	10.5
Merced				68	4	5.9
Modoc				71	10	14.1
Mono				273	58	21.2
Monterey				125	15	12.0
Napa				24	0	0.0
Nevada				150	52	34.7
Orange	275	20	7.3	580	35	6.0
Placer				32	2	6.3
Plumas	9	2		76	16	21.1
Riverside	299	59	19.7	1119	114	10.2
Sacramento				36	0	0.0
San Bernardino	16	0		332	29	8.7
San Diego	15	0		406	19	4.7
San Francisco				30	0	0.0
San Joaquin				11	1	9.1
San Luis Obispo				105	11	10.5
San Mateo	12	1	8.3	163	12	7.4
Santa Barbara				322	87	27.0
Santa Clara				43	0	0.0
Shasta				32	4	12.5
Sierra	22	2	9.1	68	11	16.2
Siskiyou				122	12	9.8
Solano				3	0	0.0
Sonoma				133	1	0.8
Stanislaus				15	0	0.0
Tehama				35	5	14.3
Trinity				24	8	33.3
Tulare				20	2	10.0
Tuolumne				130	23	17.7
Ventura				190	10	5.3
Yolo				24	0	0.0
Yuba				31	0	0.0
Douglas, NV	5	1	20.0	5	1	20.0
Total	**933**	**153**	**16.4**	**7251**	**917**	**12.6**

Source: California Department of Health Services

Plague Surveillance and Control

The California Department of Health Services (CDHS) supervises local, state, and federal agencies to conduct a cooperative statewide plague surveillance program. CDHS collects, collates, and analyzes information on suspect and confirmed plague activity among humans, domestic pets, and wild animals throughout California. This report summarizes plague activity in California for 2003.

Human cases
There were no confirmed human plague cases in California in 2003.

Domestic pets
Veterinarians submitted specimens from four domestic cats (one serum and three lymph node aspirates) and one dog (serum) with clinical signs suggestive of plague to the CDHS Microbial Diseases Laboratory (MDL) for testing. All specimens were negative for evidence of infection with *Yersinia pestis*.

Wild animals
As part of the CDHS statewide cooperative plague surveillance program, blood samples were collected from 358 wild carnivores and 13 feral pigs from 24 California counties and tested for antibody to *Y. pestis* (Table 3; Figure 1). An additional 40 carnivores were sampled through independent plague surveillance programs in Los Angeles and San Diego Counties. Of the 398 total carnivores tested, antibodies to *Y. pestis* were detected in 24 (6.0%) specimens, including 20 of 281 coyotes, 2 of 22 black bears, and 1 of 13 bobcats. Antibodies to *Y. pestis* were recorded in carnivore specimens from five counties: El Dorado, Kern, Modoc, Placer, and Plumas. Estimated seroprevalences to *Y. pestis* were highest in Modoc (12 of 40, 30%) and Kern (7 of 39, 18%) Counties.

Wild rodents were sampled and tested for antibody to *Y. pestis* from 13 California counties through the cooperative program and through independent programs in Los Angeles and San Diego Counties. *Y. pestis* antibody was detected in rodents from five counties: Lassen, Mono, Nevada, San Diego, and San Mateo. Sites in Lassen, Mono, and San Diego Counties where serologic evdience of plague was detected included U.S. Forest Services (USFS) recreation areas in three National Forests: Lassen, Inyo, and Cleveland. Plague warning signs were posted at these sites and plague preventive information was provided to USFS staff and visiting public.

Eleven wild rodents from seven counties were submitted to the CDHS MDL for bacteriologic culture. *Yersinia pestis* was cultured from one yellow-pine chipmunk from Kidd Lake, Placer County. VBDS biologists, in conjunction with the Placer County Environmental Health Department, conducted an environmental investigation of the site where the animal was collected. Three additional chipmunks and four ground squirrels captured at the site were negative for serum antibodies to *Y. pestis* and no further evidence of plague activity was noted. Plague warning signs were posted and preventive information was provided to local residents and workers. The Placer County Environmental Health Department issued a press release to alert the public about plague activity in the area and to provide preventive recommendations.

Table 3. Mammals tested for plague in California, 2003 (All specimens are sera except where otherwise indicated).

County Location[1]	**No. rodents tested**	**No. carnivores tested**	**Positive specimens**		
			Species	**Result**	**Month**
Alameda	0	8			
Calaveras	1	0			
Contra Costa	0	5			
El Dorado	2	8			
Somerset, 2S			Raccoon	1:32	August
South Lake Tahoe, 0.75 W stateline			Coyote	1:256	July
Fresno	3	6			
Humbodlt	0	3			
Inyo	19	0			
Kern	0	39			
Bakersfield			Black bear	1:64	June
Frazier Park			Coyote	1:1024	May
Granite Station			Coyote	1:512	June
Keene			Bobcat	1:256	August
Walker Basin			Black bear	1:128	August
Woody			Coyote	1:1024	July
Woody			Coyote	1:1024	August
Lassen	45	1			
Lassen NF, Crater Lake Mountain			Chipmunk, LP	1:128	July
Lassen NF, Crater Lake Mountain			Chipmunk, S	1:1024	July
Lassen NF, Crater Lake Mountain			Chipmunk, S	1:128	July
Lassen NF, Crater Lake Mountain			Chipmunk, S	1:4096	July
Lassen NF, Crater Lake Mountain			Chipmunk, S	1:512	July
Lassen NF, Crater Lake Mountain			Chipmunk, S	1:64	July
Los Angeles [2]	282	67			
Mariposa	0	9			
Mendocino	0	5			
Modoc	0	40			
Fort Bidwell, 6N			Coyote	1:512	July
Canby Creek			Coyote	1:256	June
Eagleville, 17S			Coyote	1:32	June
Lake City, 3E			Coyote	1:512	July
Likely, 10E			Coyote	1:512	July
Likely, 15E			Coyote	1:64	July
Likely, 8E			Coyote	1:512	May
Likely, 8W			Coyote	1:1024	May
Likely, 8W			Coyote	1:512	May
Likely, 9E			Coyote	1:1024	July
Madeline, 15E			Coyote	1:1024	June
Madeline, 15E			Coyote	1:1024	June
Mono	20	0			
Inyo NF, Crestview fire station			Chipmunk	1:128	July
Inyo NF, Crestview fire station			Chipmunk	1:128	July
Monterey	65	75			

Source: California Department of Health Services

Table 3, continued. Mammals tested for plague in California, 2003 (All specimens are sera except where otherwise indicated).

County Location[1]	**No. rodents tested**	**No. carnivores tested**	**Positive specimens**		
			Species	**Result**	**Month**
Nevada	13	4			
Donner Memorial SP			Pine squirrel	1:2048	May
Placer	8	2			
Kidd Lake, near Soda Springs			Chipmunk, YP[3]	POS	June
Plumas	0	10			
Beckwourth, 7N			Coyote	1:32	May
Beckwourth, 8N			Coyote	1:64	May
Vinton, 2W			Coyote	1:128	May
Riverside	383	0			
San Bernardino	209	0			
San Diego	64	2			
William Heise CP			CA G Sq	1:32	June
William Heise CP			CA G Sq	1:512	June
Cleveland NF, Observatory CG			CA G Sq	1:8192	July
Cleveland NF, Observatory CG			CA G Sq	1:32	August
Cleveland NF, Fry Creek CG			CA G Sq	1:512	July
Cleveland NF, Fry Creek CG			CA G Sq	1:512	July
San Luis Obispo	5	40			
San Mateo	29	8			
San Bruno Mtn CP and SP			Deer mouse	1:32	May
San Bruno Mtn CP and SP			Deer mouse	1:64	May
Santa Barbara	22	5			
Santa Clara	0	8			
Santa Cruz	0	1			
Shasta	0	3			
Sierra	0	9			
Siskiyou	0	17			
Trinity	0	5			
Tuolumne	0	7			
Ventura	40	0			
Total	**1210**	**387**			

[1] Mileage and direction from nearest town may be indicated
[2] Plague surveillance and test results submitted by Los Angeles County Department of Health Services
[3] Carcass

Abbreviations

Location: NF, National Forest
NP, National Park
CG, Campground
SP, State Park
CP, County Park

Species: CA G Squirrel, California ground squirrel
Chipmunk LP, Lodgepole chipmunk
Chipmunk M, Merriam's chipmunk
Chipmunk S, Shadow chipmunk
Chipmunk YP, Yellow-pine chipmunk

Source: California Department of Health Services

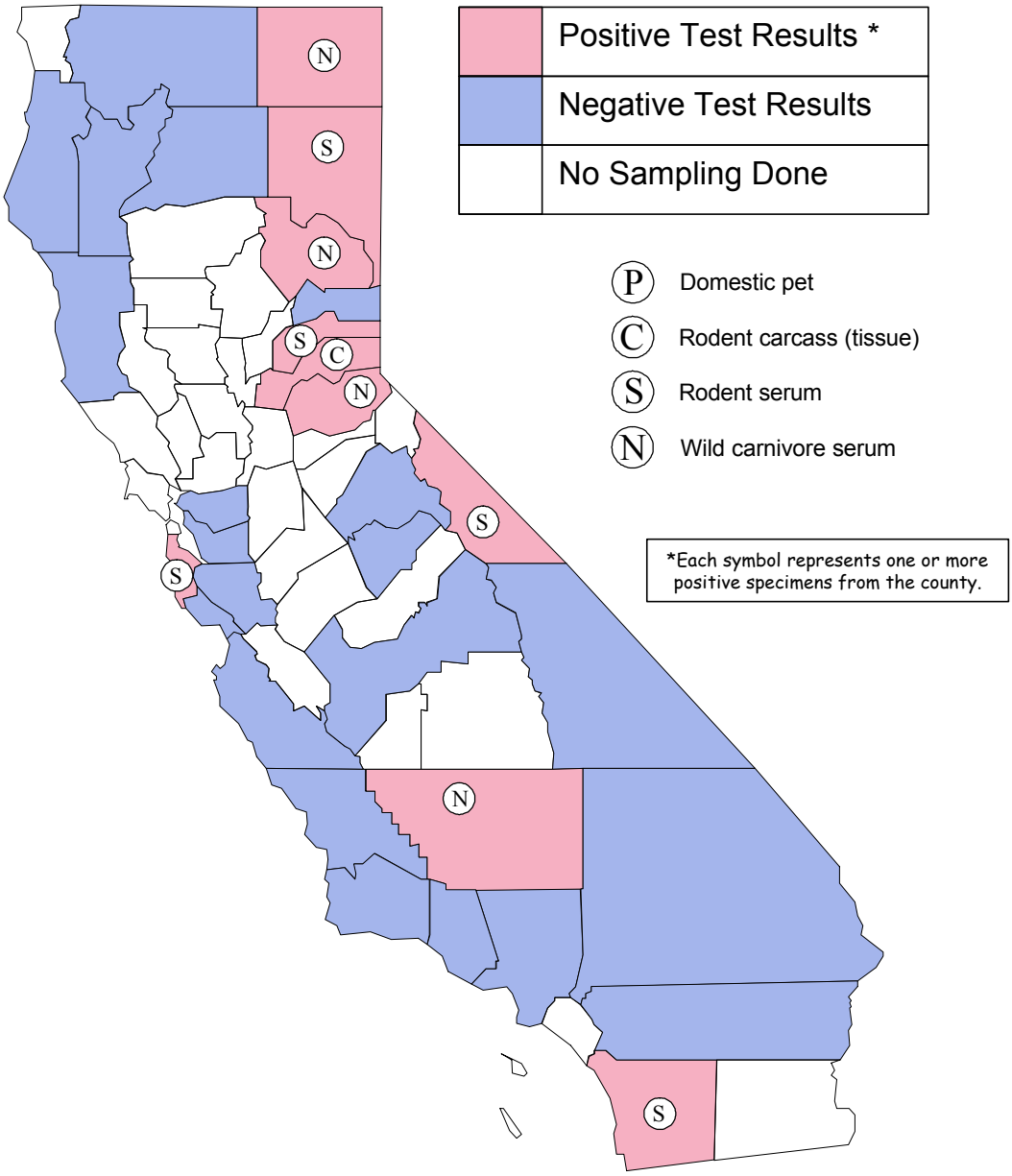

Figure 1. Distribution of specimens tested for evidence of *Yersinia pestis*, by county, 2003.

Source: California Department of Health Services

Tick-borne Disease Surveillance

Human disease surveillance

Lyme disease

A total of 86 cases of Lyme disease were reported to the California Department of Health Services (CDHS) in 2003. Case-patients were residents of 26 counties (Table 4). Sonoma County reported the most cases (9). Population-adjusted incidence was highest in Mono County at 23.4 cases per 100,000 residents (Figure 2). Of 51 cases for whom site of likely exposure was reported, 29 (57%) had exposure outside their county of residence; 20 (39%) of these reported exposure outside California. The most frequently reported locations of exposure were in Mendocino (7), Sonoma (4), and Marin (4) Counties.

The median age of reported Lyme disease cases was 39.5 years (range, 4 to 77 years) and 47 (55%) were male. Of 77 cases for which race was reported, 73 (95%) were white. Erythema migrans (EM) was identified in 61 (71%) cases. Of 56 cases with EM for which date of illness onset was reported, 42 (75%) occurred between May and August.

Rocky Mountain spotted fever

One case of Rocky Mountain spotted fever was reported in 2003. A 36-year-old female resident of Sonoma County developed a puritic rash on her hands and feet in early June. Serology conducted at the CDHS Viral and Rickettsial Disease Laboratory showed elevated IgM antibody (titer >320) to *Rickettsia rickettsii* in specimens collected in early June and early July. The patient recovered following seven days of treatment with doxycycline. The case-patient reported no history of travel outside the Sonoma County area nor recollection of a tick bite. The case-patient claimed to not engage in any outdoor activities. Evaluation of the case-patient's neighborhood by CDHS Vector-Borne Disease Section (VBDS) Public Health Biologists revealed grassy oak woodland near her residence that appeared to be suitable tick habitat. Preliminary tick surveillance efforts were unrevealing, likely due to the hot, dry summer conditions at the time. Further tick surveillance in this area is planned for 2004.

Tick-borne relapsing fever

Six cases of tick-borne relapsing fever were reported to CDHS in 2003. Case-patients were 3 to 71-years-old. Cases were residents of four counties (Mono, Placer, Santa Clara, Sonoma), but five case-patients were infected while in the greater Lake Tahoe area.

In April, staff from VBDS, Mono County Health Department and Environmental Health, and Inyo County Environmental Health Services, continued tick surveillance in response to cases of relapsing fever identified in 2001 and 2002 at the Inyo National Forest, Mono County. Thirty-six adult, 102 nymphal, and 19 larval *Ornithodoros hermsi* ticks were collected from woodpecker/chipmunk nests in the wall voids of a building. Most of the ticks were collected from the insulation of the wall voids adjacent to the nests and not in the nests themselves. The ticks were forwarded to a collaborating laboratory at the University of California, Irvine, where genetic evidence of *B. hermsii* was detected in three of five pools of *O. hermsi* by polymerase chain reaction (PCR). Further surveillance at the site in December yielded one nymphal *O. hermsi* from a chipmunk nest found in a birdhouse attached to an adjacent storage building. Although rodent nests were discovered in the building, no additional ticks were collected.

Tick surveillance

VBDS and collaborating agencies conducted tick surveillance in 14 counties in 2003. A total of 5,430 *Ixodes pacificus* (5,364 adults and 66 nymphs), 288 adult *Dermacentor occidentalis*, and

18 adult *D. varibilis* were collected. Of these, 3,906 *I. pacificus* (3,843 adults and 63 nymphs) were tested for B*orrelia burgdorferi* in four laboratories (Table 5). Ticks were tested by culture, direct fluorescent antibody (DFA), indirect fluorescent antibody (IFA), and/or PCR. Evidence of *B. burgdorferi* was identified in ticks collected from Contra Costa, Sacramento, Shasta, Sonoma, and Yolo Counties.

In 2003, VBDS collaborated with the U.S. Army Center for Health Promotion and Preventive Medicine–West to detect *B. burgdorferi* and other *Borrelia* in ticks. A total of 1,812 *I. pacificus* (1,785 adults and 27 nymphs) collected from Los Angeles, Placer, Riverside, San Bernardino, Santa Barbara, Santa Cruz, Shasta, Sonoma, and Trinity Counties were tested initially by PCR for *Borrelia* spirochetes not in the *B. burgdorferi* complex. One pool of ten ticks from Sonoma Development Center, Sonoma County, tested positive for a *Borrelia* species with a genetic sequence 99 percent similar to *Borrelia miyamotoi*, a *Borrelia* in the relapsing fever genetic complex. This species of spirochete is not known to be pathogenic to humans.

VBDS conducted the second year of tick surveillance at one site in Butte County (Loafer Creek State Recreation Area) and four sites in the Shasta-Trinity National Forest in Shasta County (Hirz Bay, Moore Creek, Packers Bay Fish Loop Trail, Pine Point). Adult *I. pacificus* ticks were collected monthly from January through April and tested for *B. burgdorferi* infection by IFA conducted at the Washoe County Environmental Health Department of Nevada. Prevalence estimates of *B. burgdorferi* in *I. pacificus* ticks remained consistent from previous years at the Loafer Creek and Moore Creek sites (Table 5). The prevalence of *B. burgdorferi* in *I. pacificus* ticks increased at the Hirz Bay (0% in 2001 to 10% in 2003) and Packers Bay Fish Loop Trail (0% in 2002 to 5.5% in 2003) sites. Pine Point was surveyed for the first time in 2003 and *B. burgdorferi* was detected in no ticks from this site. Results of this surveillance work were used in risk reduction recommendations communicated to local park and National Forest personnel.

A study of the biology of *I. pacificus* in southern California, which was initiated in 2001, continued in 2003. VBDS and collaborating agencies (Los Angeles County Department of Health Services, Los Angeles County West Vector Control District, and Riverside County Department of Environmental Health) monitored tick populations and collected questing ticks from a total of six sites at three different geographic locales (Griffith Park, Santa Monica Mountains, and San Jacinto Mountains). Meterological factors, such as rainfall and humidity, were simultaneously monitored. A total of 706 adult *I. pacificus* were collected: 375 from Griffith Park, 148 from the Santa Monica Mountains, and 183 from the San Jacinto Mountains. Data on tick populations, infection with *B. burgdorferi*, and meterological factors, will continue to be collected to gain a better understanding of the ecology of *I. pacificus* ticks and *B. burgdorferi* in southern California.

In April 2003, two *I. pacificus* nymphs were recovered from rodent nesting material in a rustic building in the Inyo National Forest, Mono County. This is the first time *I. pacificus* ticks have been documented in Mono County. Currently, at least one *I. pacificus* tick has been documented in 56 of California's 58 counties. Alpine and Modoc Counties are the only California counties in which at least one *I. pacificus* has not been observed.

Table 4. Reported Lyme disease cases by county of residence, California, 1994-2003.

County	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Incidence per 100,000 person-years
Alameda	1	2	2	3	6	3	4	3	5	1	0.21
Alpine	0	0	0	0	0	0	0	0	0	0	0.00
Amador	0	0	0	0	0	1	0	1	0	0	0.57
Butte	0	1	4	53	13	18	3	1	3	2	4.79
Calaveras	0	0	0	0	0	0	1	0	0	0	0.25
Colusa	0	0	0	0	0	0	0	0	0	0	0.00
Contra Costa	2	0	1	6	2	1	1	5	3	4	0.26
Del Norte	0	2	0	1	0	1	0	0	2	0	2.17
El Dorado	2	4	0	3	2	1	0	0	0	0	0.75
Fresno	0	0	1	0	0	0	1	0	0	0	0.02
Glenn	0	0	0	2	0	1	1	0	0	0	1.50
Humboldt	2	4	5	19	20	14	10	4	4	5	6.85
Imperial	0	0	0	1	0	0	0	0	0	0	0.07
Inyo	0	0	0	0	0	0	0	1	0	0	0.55
Kern	2	1	1	2	2	2	2	0	2	1	0.22
Kings	0	0	0	0	0	0	0	0	0	0	0.00
Lake	1	2	0	1	2	1	0	1	0	1	1.53
Lassen	0	0	0	2	1	2	0	0	2	0	2.04
Los Angeles	2	5	2	6	3	7	2	9	6	7	0.05
Madera	0	0	0	0	0	1	0	0	0	0	0.08
Marin	2	10	0	4	8	4	3	1	4	4	1.61
Mariposa	0	0	0	0	0	0	0	0	1	0	0.59
Mendocino	4	12	3	2	16	8	7	4	11	6	8.40
Merced	0	0	0	2	0	1	1	0	0	0	0.19
Modoc	0	0	0	0	0	0	0	0	0	0	0.00
Mono	0	1	1	0	0	1	0	0	0	3	4.67
Monterey	1	2	0	2	1	2	1	0	5	1	0.37
Napa	0	0	1	3	0	2	2	3	3	0	1.12
Nevada	8	0	2	1	4	5	9	6	3	4	4.56
Orange	0	0	0	0	1	2	3	0	3	2	0.04
Placer	2	1	0	5	4	2	1	4	3	0	0.88
Plumas	0	1	3	0	2	1	0	1	0	0	3.86
Riverside	2	0	1	0	0	0	3	2	1	2	0.07
Sacramento	0	1	0	5	1	1	3	4	1	4	0.16
San Benito	0	0	0	0	0	0	0	1	1	0	0.37
San Bernardino	3	1	0	0	0	1	1	0	0	2	0.05
San Diego	7	6	5	4	0	16	9	3	7	2	0.21
San Francisco	1	1	4	1	7	1	2	3	3	3	0.33
San Joaquin	2	0	1	2	0	0	0	0	0	0	0.09
San Luis Obispo	1	0	1	0	1	1	1	0	0	0	0.20
San Mateo	2	1	2	3	4	4	2	4	4	5	0.44
Santa Barbara	0	3	1	1	3	0	0	1	2	2	0.32
Santa Clara	3	2	2	4	6	2	2	2	6	4	0.19
Santa Cruz	2	3	2	2	2	2	5	9	1	8	1.40
Shasta	3	1	1	0	2	0	0	2	1	0	0.61
Sierra	0	0	0	0	0	0	0	0	0	0	0.00
Siskiyou	1	0	0	1	1	0	0	1	1	0	1.12
Solano	0	0	0	0	0	0	1	1	0	0	0.05
Sonoma	3	11	13	10	15	14	8	6	4	9	2.02
Stanislaus	1	0	3	1	0	0	1	1	0	0	0.16
Sutter	0	0	0	1	0	0	1	1	0	0	0.38
Tehama	1	0	0	1	1	0	2	0	0	0	0.90
Trinity	0	0	1	0	1	13	1	1	1	1	14.62
Tulare	3	1	1	0	1	1	0	2	0	2	0.30
Tuolumne	0	0	1	0	0	0	0	2	1	0	0.73
Ventura	0	0	0	0	2	1	2	2	1	1	0.12
Yolo	1	0	0	0	0	0	0	0	2	0	0.18
Yuba	3	1	0	0	1	1	0	0	0	0	0.99
Total	**68**	**80**	**65**	**154**	**135**	**139**	**96**	**92**	**97**	**86**	**0.30**

Source: California Department of Health Services

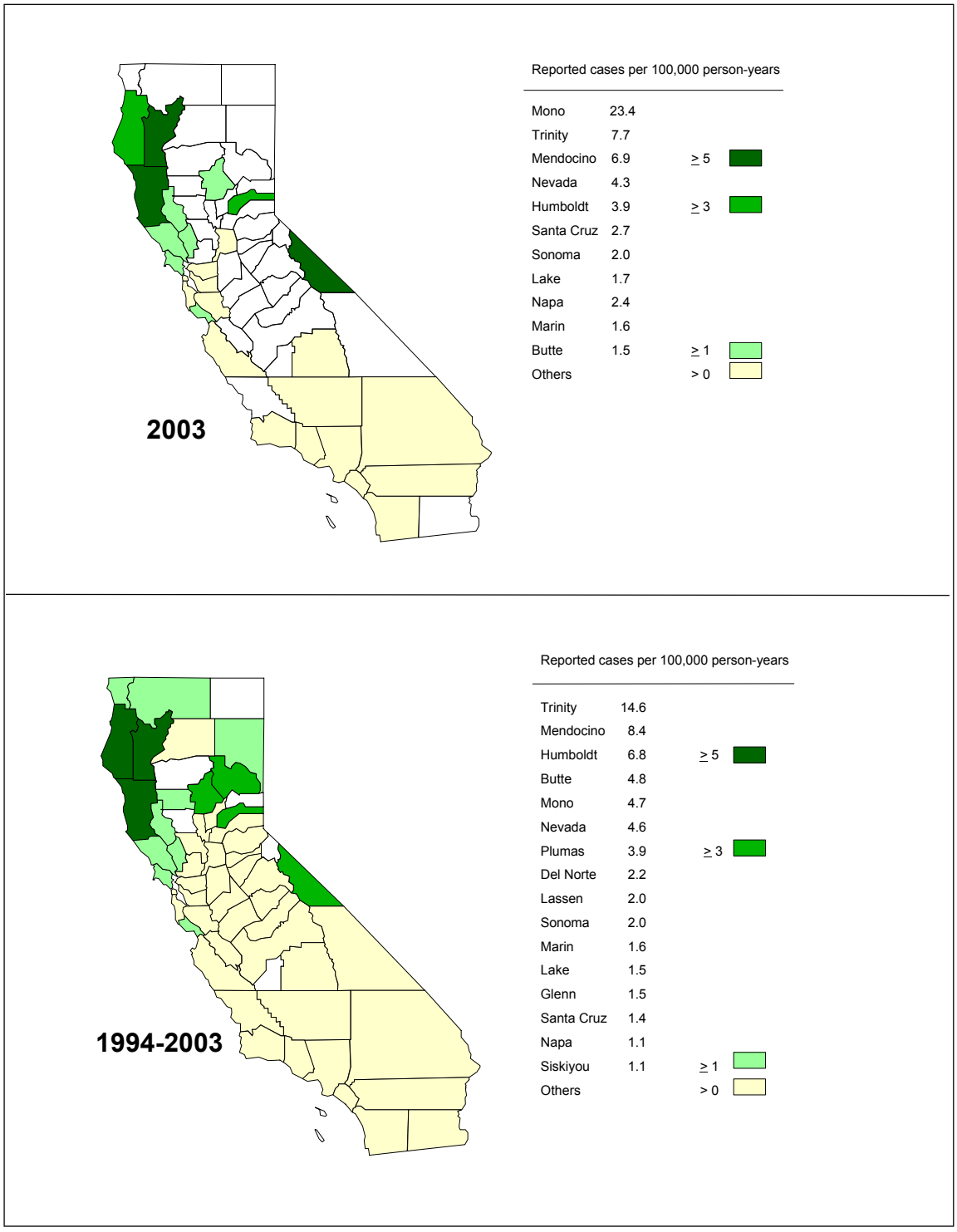

Figure 2. Reported incidence of Lyme disease by county, California, 1994-2003.

Source: California Department of Health Services

Table 5. *Ixodes pacificus* ticks tested for evidence of *Borrelia burdorferi*, California, 2003.

County	Location	No. ticks tested	No. pools tested	No. pools positive				Laboratory
				Culture	DFA	IFA	PCR	
Butte	Loafer Creek State Recreation Area	353	353			16		Washoe Co EH
Contra Costa	Briones Regional Park	76	76			0		CCCMVCD
	Lafayette	364	364			15		CCCMVCD
	Orinda	56	56			0		CCCMVCD
	San Ramon, Bollinger Caynon	100	100			2		CCCMVCD
	Walnut Creek	54	54			0		CCCMVCD
Los Angeles	Catalina Island	211	24				0	US Army
	Santa Monica Mountain	48	6				0	US Army
Placer	Auburn State Recreation Area *	6	6		0			Sac/Yolo MVCD
	Colfax *	27	27		0			Sac/Yolo MVCD
	Driver's Flat	377	40				0	US Army
Riverside	Cleveland National Forest	33	5				0	US Army
Sacramento	Ancil Hoffman	1	1		0			Sac/Yolo MVCD
	Mississippi Bar	264	27		1			Sac/Yolo MVCD
	Negro Bar	14	7		0			Sac/Yolo MVCD
	Nimbus Dam	96	15		1			Sac/Yolo MVCD
	Snipes Park	68	14		0			Sac/Yolo MVCD
	Willow Creek	33	12		0			Sac/Yolo MVCD
San Bernardino	San Bernardino National Forest	121	14				0	US Army
San Joaquin	Carnegie State Vehicular Recreation	6	5		0			Sac/Yolo MVCD
	Comanche	21	4		0			Sac/Yolo MVCD
Santa Barbara	Carpinteria	24	2				0	US Army
	Goleta	19	2				0	US Army
	Los Padres National Forest	42	6				0	US Army
	Santa Barbara	10	2				0	US Army
Santa Cruz	Nisene Marks State Park	64	7				0	US Army
Shasta	Shasta National Forest, Bailey Cove	17	17			0		Washoe Co EH
	Shasta National Forest, Hirz Bay	48	48			5		Washoe Co EH
	Shasta National Forest, Moore Creek	42	42			1		Washoe Co EH
	Shasta National Forest, Packers Bay	35	35			2		Washoe Co EH
	Shasta National Forest, Packers Bay *	1	1			0		Washoe Co EH
	Shasta National Forest, Pine Point	69	69			0		Washoe Co EH
	Shasta-Trinity Whiskeytown Nat Rec	90	10				0	US Army
Sonoma	Sonoma Development Center	173	20				2	US Army
	Sonoma Development Center *	27	3				0	US Army
Trinity	Douglas City	99	12				0	US Army
	Lewiston	52	6				0	US Army
	Trinity National Forest	456	45				0	US Army
Yolo	Cache Creek	307	33†		2		1	Sac/Yolo MVCD
	Cache Creek *	2	1	1	1		1	Sac/Yolo MVCD
Total pools positive				**1**	**5**	**41**	**4**	
Total pools tested				**1**	**119**	**1215**	**205**	

* Nymphs

† Two pools were tested by both DFA and PCR

Source: California Department of Health Services

Mosquito-Borne Encephalitis Virus Surveillance

The California Arbovirus Surveillance Program is a cooperative effort of the California Department of Health Services (CDHS), the University of California at Davis's Center for Vectorborne Diseases (CVEC), the Mosquito and Vector Control Association of California, local mosquito and vector control agencies, county and local public health departments, and physicians and veterinarians throughout California. (Local agencies that participated in the statewide mosquito-borne encephalitis surveillance program are listed in Table 6.) Additional collaborating agencies in the West Nile virus (WNV) surveillance program included the California Department of Food and Agriculture, California Animal Health and Food Safety Laboratory (CAHFS), California Department of Fish and Game, the U.S. Fish and Wildlife Service, and the Centers for Disease Control and Prevention (CDC).

In 2003, the following activities comprised the California Arbovirus Surveillance Program:

1) Diagnostic testing of specimens from human patients exhibiting symptoms of viral meningitis, encephalitis, acute flaccid paralysis/atypical Guillain-Barré, and febrile illness.
2) Enrollment of patients diagnosed with encephalitis into the California Encephalitis Project, which evaluates clinical course, demographics, exposure to arthropods, and laboratory evidence to determine etiology.
3) Diagnostic testing of specimens from equids that exhibit clinical signs of viral neurologic disease compatible with arboviral infection, including western equine encephalomyelitis (WEE), WNV, and other arbovirus as appropriate.
4) Monitoring and testing of mosquitoes for the presence of St. Louis encephalitis (SLE), WEE, and WNV. Tests were also performed for California encephalitis (CE), dengue, and other arboviruses as appropriate.
5) Serological monitoring of sentinel chickens for antibodies to SLE, WEE, and West Nile viruses.
6) Surveillance and diagnostic testing of dead birds, especially crows and ravens, for infection with WNV.
7) Weekly reporting in the CDHS Arbovirus Surveillance Bulletin and on the website (www.westnile.ca.gov) of arbovirus testing results in California and arbovirus activity throughout the United States.

Arbovirus diagnostic procedures used in 2003 in California are summarized in Table 7.

Human disease surveillance

The CDHS Viral and Rickettsial Disease Laboratory (VRDL) tested sera and/or cerebrospinal fluid specimens from 1,112 patients for antibodies to WEE, WNV, and SLE, including 294 patients enrolled in the California Encephalitis Project. Cases represented 312 patients with encephalitis, 490 with aseptic meningitis, 11 with acute flaccid paralysis/atypical Guillain-Barré, and 299 with febrile illness. Of these, sera from 352 patients were first screened for arboviral antibodies at one of 30 county public health laboratories.

Three human cases of WNV with likely exposure in California were identified in 2003 (Table 8). A 31-year-old male resident of Riverside County was diagnosed with aseptic meningitis on September 28, 2003. A 46-year-old male resident of Imperial County was diagnosed with aseptic meningitis on October 5, 2003. A 61-year-old male resident of Los Angeles County

was diagnosed with a febrile illness on October 18, 2003. VRDL detected antibody titers to WNV that were higher than those for SLE, WEE, and dengue in sera from all three patients. Plaque reduction neutralization tests (PRNT) were performed at VRDL and confirmed acute WNV infection for all three cases. All three patients survived.

The VRDL identified 20 cases of WNV infection acquired outside of California in 2003. Eighteen cases were California residents who were exposed during travel to other areas of the United States; two cases were residents of other states who became ill and were diagnosed while visiting California (Table 8).

No cases of WEE or SLE were identified in California in 2003.

Equine surveillance

Serum and brain tissue specimens from 208 horses displaying neurological signs were submitted to CAHFS and CVEC for arboviral testing.

The first confirmed equine WNV case with exposure in California was identified in October. A 20-year-old Missouri Foxtrotter gelding, stabled in the city of Alpine, San Diego County, developed clinical signs on October 17 (Table 9). Serum antibodies to WNV were detected by IgM capture enzyme immunoassay (EIA) and PRNT. The horse had not been vaccinated against WNV nor traveled outside California.

Two imported equine WNV cases were reported in 2003. A three-year-old American Quarter Horse stallion, imported from Toyah, Texas, on July 15, developed neurological signs consistent with WNV, including ataxia and facial paralysis, on July 17. Serum antibodies to WNV were detected by IgM capture EIA and PRNT.

A ten-year-old American Quarter Horse gelding which resided in Arizona developed clinical signs on October 15 while traveling in Riverside County. The horse had been vaccinated for WNV in 2002 and had received a booster in August 2003. Serum IgM antibody to WNV was detected by capture EIA and PRNT.

Adult mosquito surveillance

Thirty-five local mosquito control agencies from 29 counties maintained a total of 622 New Jersey light traps (Table 6) and contributed data to the VBDS adult mosquito occurrence report, which was distributed weekly from April 3 to November 5.

Forty-two local mosquito control agencies from 31 counties submitted a total of 422,388 mosquitoes (10,297 mosquito pools) to CVEC for virus isolations (Tables 6, 10-14). CVEC detected WNV in 26 of 4,462 pools of *Culex tarsalis* and 6 of 2,564 pools of *Culex quinquefasciatus*, SLE virus in 4 pools of *Cx. tarsalis* and 1 pool of *Cx. quinquefasciatus*, CE virus in 5 of 323 pools of *Ochleroatatus melanimon*, and WEE virus in 1 pool of *Cx. tarsalis* (Table 15; Figures 3-4). WNV was first detected in mosquitoes in California in a pool of *Culex tarsalis* collected on July 16 from El Centro, Imperial County.

Chicken serosurveillance

Fifty-two local mosquito and vector control agencies in 36 counties maintained 226 sentinel chicken flocks (Table 6; Figure 5). Blood samples were collected from chickens every other week between April 16 and October 29, 2003. The VRDL tested 30,798 chicken sera for antibodies to SLE, WNV, and WEE by EIA. The Sacramento-Yolo Mosquito and Vector

Control District (1,568 samples) and the San Gabriel Valley Mosquito and Vector Control District (1,464 samples) tested their own sentinel chicken flocks.

A total of 70 seroconversions to WNV were detected among nine flocks from Imperial (54) and Riverside (16) Counties (Tables 9, 16-17; Figures 3 and 6). The first seroconversions to WNV were provisionally detected by EIA of filter paper strips obtained on August 4 from six chickens in two Imperial County flocks (Table 16). WNV was confirmed by PRNT on whole blood collected on August 20.

Seroconversions to SLE were identified in flocks in Imperial (2), Los Angeles (2), Riverside (8), and San Bernardino (1) Counties (Table 16; Figure 3). The first seroconversions to SLE were detected in specimens obtained on September 2 from a flock in Imperial County. The last seroconversions for 2003 were detected in specimens obtained on October 16 from a flock in Riverside County (Table 16).

Seroconversions to WEE were detected in specimens obtained on November 4 from two chickens in a flock in San Diego County (Table 16; Figure 3).

Dead bird surveillance for West Nile virus

The WNV dead bird surveillance program, a collaborative program between CDHS and over 130 local agencies and supported by a grant from CDC, was established in 2000 and expanded in 2003. In 2003, the toll-free hotline (1-877-WNV-BIRD) received 8,650 reports of dead birds from 57 counties. During the first eight months of 2003, collection and testing of birds focused on corvids (i.e., crows, ravens, jays, and magpies), raptors, finches, and sparrows. Subsequent to the detection of WNV in southern California, the program expanded to include all wild bird species with the exception of doves and pigeons.

A total of 1,765 birds from 51 counties was tested for WNV (Table 18; Figure 7). WNV was detected for the first time among dead wild birds in California in September 2003. CVEC detected WNV by both polymerase chain reaction and virus isolation from a dead crow collected on September 3 in the city of Arcadia, Los Angeles County. In total, WNV was detected in 96 bird carcasses from Los Angeles, Orange, Riverside, San Bernardino, and San Diego Counties (Figure 7).

Weekly arbovirus surveillance bulletin and West Nile virus website

Between April 18 and December 30, CDHS published weekly bulletins that reported results of arbovirus tests for human, equids, mosquitoes, sentinel chickens, and dead birds, as well as updates on national WNV activity. These bulletins were distributed to local, state, and federal public health agencies, universities, and other state health departments; the bulletins were also posted on the California WNV website (www.westnile.ca.gov). The website also provided WNV facts, press releases, maps of WNV activity, an on-line dead bird reporting form, and links to related websites. Pictures of birds were added to the website to assist the public to better identify bird species when reporting bird carcasses.

Table 6. Participation by local agencies in the California mosquito-borne encephalitis surveillance program, 2003.

County	Agency	Agency code	Jersey Light Traps	Mosquito pools	No. flocks	No. chickens	samples tested	Birds reported	Birds tested
Alameda	Alameda Co. MAD	ALCO	13	75	3	26	254	227	31
Amador								26	4
Butte	Butte Co. MVCD	BUCO	26	10	7	70	985	239	30
Calaveras								15	2
Colusa	Colusa MAD	CLSA	3		1	10	130	11	2
Contra Costa	Contra Costa MVCD	CNTR	22	365	4	43	721	456	54
Del Norte								3	1
El Dorado								144	13
Fresno	Consolidated MAD	CNSL	12	74	5	51	679	180	21
Fresno	Fresno MVCD	FRNO	9	27	2	25	150		
Fresno	Fresno Westside MAD	FRWS	10	38	2	28	208		
Glenn	Glenn Co. MVCD	GLEN	5	22	2	26	358	9	4
Humboldt								21	5
Imperial	Coachella Valley MVCD	IMPR			3	30	676	28	8
Imperial	Imperial Co. Environmental Health	IMPR		532	2	38	232		
Inyo	Owens Valley MAP	INYO		175	3	31	403	72	10
Kern	Arbovirus Field Station	AFSB		122					
Kern	Delano MAD	DLNO	8		2	20	220	70	13
Kern	Kern MVCD	KERN	20	558	9	92	1,259		
Kern	South Fork MAD	SFMO		1					
Kern	Westside MVCD	WEST	17		3	30	438		
Kings	Kings MAD	KNGS	9		3	30	304	20	2
Lake	Lake Co. VCD	LAKE		202	2	20	259	19	3
Los Angeles	Antelope Valley MVCD	ANTV	13		5	35	463	1,619	343
Los Angeles	Greater Los Angeles Co. VCD	GRLA	17	1,659	5	50	870		
Los Angeles	Long Beach Environmental Health	LONG		328	4	37	626		
Los Angeles	Los Angeles Co. West VCD	LACW		179	20	120	1,827		
Los Angeles	San Gabriel Valley MVCD	SGVA		37	11	64	1,476		
Madera	Madera Co. MVCD	MADR	5	21	2	22	199	31	1
Marin	Marin-Sonoma MVCD	MARN	29		5	55	680	99	15
Mariposa								9	1
Mendocino								33	5
Merced	Merced Co. MAD	MERC	18	5	6	36	509	159	21
Merced	Turlock MAD	TRLK		224					
Mono								11	2
Monterey	North Salinas MAD	NSAL	17		1	10	161	54	12
Napa	Napa MAD	NAPA			2	11	141	30	6
Nevada								76	3
Orange	Orange Co. VCD	ORCO		571	1	10	180	414	119
Placer	Placer Co. VCD	PLCR	15	16	5	55	768	150	19
Riverside	Coachella Valley MVCD	COAV	10	1,461	10	100	1,563	606	184
Riverside	Northwest MVCD	NWST	12	541	6	70	1,008		
Riverside	Riverside Co. Environmental Health	RIVR	13	104	6	66	1,190		
Sacramento	Sacramento-Yolo MVCD	SAYO	40	657	5	50	770	757	135
San Benito								13	2
San Bernadino	San Bernardino Co. VCP	SANB	22	123	7	70	1,211	611	121
San Bernardino	West Valley MVCD	WVAL		120	5	30	478		
San Diego	San Diego Co. Dept of Health	SAND		98	3	30	540	498	255
San Francisco								50	5
San Joaquin	San Joaquin Co. MVCD	SJCM	50	330	5	60	723	153	21
San Luis Obispo	San Luis Obispo Co.	SLOC		137	2	21	221	169	16
San Mateo	San Mateo Co. MAD	SANM			3	30	447	149	25
Santa Barbara	Santa Barbara Coastal VCD	SBCO		220	5	50	756	80	15
Santa Clara	Santa Clara Co. VCD	STCL	36	115	4	60	589	223	41
Santa Cruz	Santa Cruz Co. MVCD	SCRZ	7	50	1	9	126	54	2
Shasta	Burney Basin MAD	BURN	6		2	19	201	61	9
Shasta	Shasta MVCD	SHAS	26	94	5	61	800		
Solano	Solano Co. MAD	SOLA	25		2	22	233	91	5
Solano	Sacramento-Yolo MVCD	SAYO		297					
Sonoma	Marin-Sonoma MVCD	MARN	*		2	22	308	160	18
Stanislaus	East Side MAD	EAST			2	22	310	164	29
Stanislaus	Turlock MAD	TRLK	21	78	4	48	643		
Sutter	Sutter-Yuba MVCD	SUYA	40	274	5	50	695	69	19
Tehama	Tehama Co. MVCD	TEHA			2	22	201	17	1
Tulare	Delta VCD	DLTA	12	33	6	60	783	53	9
Tulare	Tulare MAD	TLRE	10		2	20	273		
Tuolumne								11	1
Ventura	City of Moorpark	MOOR	4		1	10	180	137	32
Ventura	Ventura Co. Environmental Health	VENT	20	39	4	40	759		
Yolo	Sacramento-Yolo MVCD	SAYO	*	253	5	50	798	239	65
Yuba	Sutter-Yuba MVCD	SUYA	*	32	2	20	245	38	9
Total			**622**	**10,297**	**226**	**2,187**	**31,227**	**8,661**	**1,769**
Bernalillo, NM	Bernalillo Co. VB	BCVB			6	13	43		
Grand, UT	Moab MAD	MOAB			2	18	302		

*The New Jersey Light Traps for Marin-Sonoma cover both Marin and Sonoma Counties
*The New Jersey Light Traps for Sacramento-Yolo cover both Sacramento and Yolo Counties
*The New Jersey Light Traps for Sutter-Yuba cover both Sutter and Yuba Counties

Abbreviations: MAD, mosquito abatement district; MVCD, mosquito and vector control district; MAP, mosquito abatement program; VCD, vector control district; VCP, vector control program

Source: California Department of Health Services

Table 7. Arbovirus diagnostic procedures for California.

	Screening	Primary Test	Confirmatory Test	Virus Tested			
				SLE	WNV	WEE	CE
Human sera	Screened by local public health labs and VRDL	EIA for SLE and WEE, IgM-EIA for WNV (VRDL)	PRNT (CVEC/VRDL)	x	x	x	-
Human cerebrospinal fluid	Screened by VRDL	EIA for SLE and WEE, IgM-EIA for WNV (VRDL)	PRNT (CVEC/VRDL)	x	x	x	-
Equine sera	Per request of the veterinarian	EIA (CVEC)	PRNT (CVEC)	-	x	x	-
Equine tissue	Screened by VPHS and CDFA	Virus isolation in VERO cells (CVEC)		-	x	x	-
Bird carcasses	Screened by VBDS; necropsy and tissue removal by CAHFS	RT-PCR using a primary set of primers on kidney tissue and cell culture on organ pools (CVEC)	RT-PCR using a set of secondary primers (CVEC)	-	x	-	-
Other animals sera	Screened by VPHS	PRNT for sera (CVEC), virus isolation (CVEC)		-	x	-	-
Mosquito pools	Collections by local agencies		*in-situ* EIA using vero cell cultures (CVEC)	x	x	x	x
Chicken sera	Local agency sentinel flocks	EIA (VRDL)	IFA (PRNT as needed - VRDL)	x	x	x	-

Abbreviations: Agencies:
CAHFS, California Animal Health and Food Safety Laboratory
CDFA, California Department of Food and Agriculture
CVEC, University of California, Davis, Center for Vector-Borne Disease
VBDS, Vector-Borne Disease Section
VPHS, Veterinary Public Health Section
VRDL, Viral and Rickettsial Disease Laboratory

Assays:
EIA, enzyme immunoassay
IFA, immunofluorescent antibody
PRNT, plague reduction neutralization test
RT-PCR, reverse transcription-polymerase chain reaction

Viruses:
SLE, St. Louis encephalitis
WEE, western equine encephalomyelitis
WNV, West Nile virus

Source: California Department of Health Services

Table 8. Human cases of infection with West Nile virus diagnosed in California, 2003.

	Age	Sex	Onset date	County of residence	Likely state/province of exposure	Clinical classification
Locally Acquired	31	M	9/28/2003	Riverside	California	WN meningitis
	46	M	10/5/2003	Imperial	California	WN meningitis
	61	M	10/8/2003	Los Angeles	California	WN fever
Imported	64	M	7/21/2003	Los Angeles	Louisiana	WN meningoencephalitis
	60	F	7/28/2003	San Diego	Sonora (Mexico)	Secondary flavivirus infection*
	55	F	8/1/2003	Kern	Colorado	WN fever
	47	F	8/7/2003	Alameda	Colorado	WN acute flaccid paralysis
	30	F	8/12/2003	Shasta	Colorado	WN fever
	68	F	8/15/2003	Riverside	Colorado, Indiana	WN encephalitis
	67	M	8/19/2003	Sacramento	Pennsylvania	WN meningitis
	57	F	8/19/2003	Alameda	Pennsylvania	WN encephalitis
	24	M	8/19/2003	Ventura	Colorado	WN fever
	62	M	8/21/2003	San Mateo	South Dakota, Utah, Colorado	WN meningoencephalitis
	79	F	8/22/2003	San Diego	South Dakota	WN meningitis
	48	M	8/24/2003	Los Angeles	Colorado	WN fever**
	41	M	8/24/2003	Los Angeles	Massachusetts	WN encephalitis
	19	F	8/24/2003	Sonoma	Wyoming	WN meningitis
	41	M	8/29/2003	Los Angeles	Colorado	WN meningoencephalitis
	19	M	8/29/2003	Los Angeles	Saskatchewan (Canada)	WN fever
	70	M	9/8/2003	Kern	Colorado	WN encephalitis
	75	F	9/23/2003	Los Angeles	Arizona, New Jersey	WN meningitis
	9	M	9/28/2003	Boulder, CO	Colorado	WN fever
	62	M	10/5/2003	Palm Beach, FL	Florida	WN meningoencephalitis

* PRNT did not distinguish flaviviruses

** Blood donor

Source: California Department of Health Services

Table 9. Timetable of West Nile virus detections, 2003.

Species	Two-week period beginning											
	Jul-6	Jul-20	Aug-3	Aug-17	Aug-31	Sep-14	Sep-28	Oct-12	Oct-26	Nov-9	Nov-23	Dec-7
Human							IMP, LA, RIV					
Mosquito pools	IMP		IMP	IMP, RIV	IMP, RIV	IMP, LA, RIV	LA	LA	IMP			
Chicken			IMP	IMP, RIV	IMP, RIV		IMP	IMP, RIV				
Wild birds					LA	LA	LA, RIV, SB, SD	LA, OR, RIV, SD	LA, OR, RIV, SB, SD	LA, RIV, SB	LA, SB	LA, SB
Horses								SD				

County: IMP=Imperial LA=Los Angeles OR=Orange RIV=Riverside SB=San Bernardino SD=San Diego

Table 10. Mosquitoes (*Culex spp.*) tested for SLE, WEE, and West Nile viruses by submitting county and agency, 2003.

		Cx erythrothorax		*Cx pipiens*		*Cx quinquefasciatus*		*Cx stigmatosoma*		*Cx tarsalis*		Total	
County	Agency	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.
Alameda	ALCO	55	2,703	16	696					3	34	74	3,433
Butte	BUCO									4	172	4	172
Contra Costa	CNTR	43	2,150			9	380	1	26	309	15,352	362	17,908
Fresno	CNSL	4	137			20	905			50	2,181	74	3,223
Fresno	FRNO									27	1,139	27	1,139
Fresno	FRWS									38	1,871	38	1,871
Glenn	GLEN									21	1,050	21	1,050
Imperial	IMPR	106	4,973			55	1,521			325	12,315	486	18,809
Inyo	INYO	28	1,066							66	2,632	94	3,698
Kern	AFSB					27	534	2	36	49	1,859	78	2,429
Kern	KERN	8	363			215	6,961			273	10,180	496	17,504
Kern	SFMO	1	22									1	22
Lake	LAKE	8	400					18	775	160	7,736	186	8,911
Los Angeles	GRLA	260	12,431	2	100	998	40,386	26	708	146	5,918	1,432	59,543
Los Angeles	LONG	2	66			238	10,636	1	15	87	3,365	328	14,082
Los Angeles	LACW	17	807			50	2,307			11	494	78	3,608
Los Angeles	SGVA					25	873			12	372	37	1,245
Madera	MADR	3	150	3	137					15	730	21	1,017
Merced	MERC									5	250	5	250
Merced	TRLK	56	2,536	14	572					131	5,682	201	8,790
Orange	ORCO	100	4,384			296	9,236	6	111	134	4,197	536	17,928
Placer	PLCR			3	150					13	427	16	577
Riverside	COAV	128	5,675			276	8,976			1,007	45,042	1,411	59,693
Riverside	NWST	150	7,096	1	50	185	7,357	56	1,720	146	5,470	538	21,693
Riverside	RIVR	29	1,313			10	183	4	60	61	2,270	104	3,826
Sacramento	SAYO	28	1,091	161	5,490			4	96	305	13,272	498	19,949
San Bernardino	SANB	18	701			32	1,017	14	123	46	1,486	110	3,327
San Bernardino	WVAL					85	3,961	1	17	34	1,574	120	5,552
San Diego	SAND	47	2,344							50	2,333	97	4,677
San Joaquin	SJCM			116	3,745	1	12			176	6,863	293	10,620
San Luis Obispo	SLOC	105	5,141	2	100					17	830	124	6,071
Santa Barbara	SBCO	47	1,945			36	1,497	6	136	62	2,738	151	6,316
Santa Clara	STCL			68	3,293					25	1,064	93	4,357
Santa Cruz	SCRZ	31	1,390	17	478					2	33	50	1,901
Shasta	SHAS	5	248	42	2,037					44	1,899	91	4,184
Solano	SAYO			238	9,201			4	64	43	1,239	285	10,504
Stanislaus	TRLK	7	283	19	658			1	41	34	1,191	61	2,173
Sutter	SUYA			11	311					262	13,007	273	13,318
Tulare	DLTA	6	208			6	241			21	739	33	1,188
Ventura	VENT	5	193							34	1,508	39	1,701
Yolo	SAYO			12	263					196	9,306	208	9,569
Yuba	SUYA			14	463					18	678	32	1,141
Total		**1,297**	**59,816**	**739**	**27,744**	**2,564**	**96,983**	**144**	**3,928**	**4,462**	**190,498**	**9,206**	**378,969**

Source: California Department of Health Services

Table 11. Mosquitoes (*Culex spp.*) tested for SLE, WEE, and West Nile viruses by submitting county and agency, 2003.

		Cx erraticus		*Cx restuans*		*Cx thriambus*		Total	
County	Agency	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.
Imperial	IMPR	7	320					7	320
Los Angeles	GRLA			4	149	16	567	20	716
Total		**7**	**320**	**4**	**149**	**16**	**567**	**27**	**1,036**

Table 12. Mosquitoes (*Aedes vexans*, *Coquillettidia perturbans*, *Culiseta* spp., *Orthopodomyia signifera*, and *Psorophora columbiae*) tested for SLE, WEE, and West Nile viruses by submitting county and agency, 2003.

		Ae vexans		*Cq perturbans*		*Cs incidens*		*Cs inornata*		*Cs particeps*		*Or signifera*		*Ps columbiae*		Total	
County	Agency	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.
Imperial	IMPR	31	1,010					8	111							39	1,121
Inyo	INYO							6	50	1	5					7	55
Kern	AFSB											1	10			1	10
Kern	KERN									1	29					1	29
Los Angeles	GRLA					108	4,916	32	1,433	10	288					150	6,637
Los Angeles	LACW					101	4,679									101	4,679
Merced	TRLK	1	50													1	50
Orange	ORCO					7	115	2	24	3	37					12	176
Riverside	COAV	30	1,013					11	221					2	91	43	1,325
Riverside	NWST									2	38					2	38
Sacramento	SAYO	41	1,656			20	616	2	41							63	2,313
San Bernardino	SANB	2	50					4	50					3	9	9	109
San Joaquin	SJCM	21	938					1	36	2	31					24	1,005
Santa Barbara	SBCO					2	68	4	109	2	61					8	238
Santa Clara	STCL					1	49	1	13	1	49					3	111
Shasta	SHAS			3	141											3	141
Solano	SAYO					6	81									6	81
Stanislaus	TRLK	16	687													16	687
Yolo	SAYO	4	114			1	7									5	121
Total		**146**	**5,518**	**3**	**141**	**246**	**10,531**	**71**	**2,088**	**22**	**538**	**1**	**10**	**5**	**100**	**494**	**18,926**

Source: California Department of Health Services

Table 13. Mosquitoes (*Ochlerotatus* spp.) tested for SLE, WEE, and West Nile viruses by submitting county and agency, 2003.

		Oc dorsalis		*Oc melanimon*		*Oc nigromaculis*		*Oc sierrensis*		*Oc taeniorhynchus*		*Oc washinoi*		Total	
County	Agency	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.
Alameda	ALCO	1	50											1	50
Butte	BUCO			6	300									6	300
Contra Costa	CNTR	3	131											3	131
Glenn	GLEN			1	50									1	50
Inyo	INYO			71	3,262									71	3,262
Kern	AFSB			43	2,075									43	2,075
Kern	KERN			59	2,519									59	2,519
Lake	LAKE			16	793									16	793
Los Angeles	GRLA							1	12			7	317	8	329
Merced	TRLK			22	962									22	962
Riverside	COAV	6	154											6	154
Sacramento	SAYO			75	3,121	1	50	3	77					79	3,248
San Joaquin	SJCM			13	395									13	395
San Luis Obispo	SLOC	13	650											13	650
Santa Barbara	SBCO									4	143	43	2,046	47	2,189
Santa Clara	STCL	17	731					1	12			1	50	19	793
Solano	SAYO			1	13									1	13
Sutter	SUYA			1	43									1	43
Yolo	SAYO			15	567			1	13					16	580
Total		**40**	**1,716**	**323**	**14,100**	**1**	**50**	**6**	**114**	**4**	**143**	**51**	**2,413**	**425**	**18,536**

Table 14. Mosquitoes (*Anopheles* spp.) tested for SLE, WEE, and West Nile viruses by submitting county and agency, 2003.

		An franciscanus		*An freeborni*		*An hermsi*		*An occidentalis*		*An punctipennis*		Total	
County	Agency	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.
Inyo	INYO			3	112							3	112
Kern	KERN					2	95					2	95
Los Angeles	GRLA					49	2,034					49	2,034
Orange	ORCO					23	574					23	574
Riverside	COAV	1	9									1	9
Riverside	NWST					1	22					1	22
Sacramento	SAYO			15	533					2	99	17	632
San Bernardino	SANB	3	19			1	10					4	29
San Diego	SAND					1	7					1	7
Santa Barbara	SBCO	1	10			13	496					14	506
Solano	SAYO			5	51							5	51
Stanislaus	TRLK							1	24			1	24
Yolo	SAYO			24	826							24	826
Total		**5**	**38**	**47**	**1,522**	**90**	**3,238**	**1**	**24**	**2**	**99**	**145**	**4,921**

Source: California Department of Health Services

Table 15. CE, SLE, WEE, and West Nile viruses isolated from mosquito pools, 2003.

Mosquito species	Date collected	County	Agency	Virus isolated							
				CE		SLE		WEE		WNV	
				pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.
Culex quinquefasciatus	16-Sep	Los Angeles	GRLA							1	50
	9-Oct	Los Angeles	GRLA							2	95
	23-Oct	Los Angeles	GRLA							3	129
	19-Nov	Los Angeles	GRLA			1	25				
Culex tarsalis	2-Jul	Riverside	COAV			1	50				
	16-Jul	Imperial	IMPR							1	50
	4-Aug	Imperial	IMPR							1	27
	7-Aug	San Diego	SAND					1	50		
	11-Aug	Riverside	COAV			1	25				
	19-Aug	Imperial	IMPR							4	160
	26-Aug	Riverside	COAV							1	45
	27-Aug	Riverside	COAV							1	23
	2-Sep	Imperial	IMPR							6	300
	4-Sep	Riverside	COAV							1	27
	9-Sep	Riverside	COAV							2	71
	11-Sep	Riverside	COAV							3	93
	16-Sep	Imperial	IMPR			1	11			4	161
	23-Sep	Riverside	COAV							1	50
	24-Sep	Riverside	COAV							1	50
	2-Oct	Riverside	COAV			1	50				
Ochlerotatus melanimon	12-Jun	Kern	KERN	3	150						
	19-Jun	Kern	KERN	1	50						
	13-Aug	Inyo	INYO	1	33						
Totals				**5**	**233**	**5**	**161**	**1**	**50**	**32**	**1,331**

Source: California Department of Health Services

Table 16. Chicken seroconversions to SLE, WEE, and West Nile viruses by location and week (Monday of week shown below) bled, 2003.

SLE

County	Agency	City	8/4	8/18	8/25	9/1	9/15	9/22	9/29	10/13	10/27	11/4	Total
Imperial	IMPR	Westmoreland				2							2
Los Angeles	SGVA	Monterey Park							2				2
Riverside	COAV	Mecca					2						2
Riverside	RIVR	Blythe					2		3	1			6
San Bernardino	SANB	Redlands						1					1
						2	**4**	**1**	**5**	**1**			**13**

WEE

County	Agency	City	8/4	8/18	8/25	9/1	9/15	9/22	9/29	10/13	10/27	11/4	Total
San Diego	SAND	Carlsbad										2	2
												2	**2**

WNV

County	Agency	City	8/4	8/18	8/25	9/1	9/15	9/22	9/29	10/13	10/27	11/4	Total
Imperial	IMPR	Seeley		4		2							6
Imperial	IMPR	El Centro		7					1				8
Imperial	IMPR	Niland	3	2		2	1		1	1	1		11
Imperial	IMPR	Niland	3	1		3	2		4*				13
Imperial	IMPR	Westmoreland				3	5		1				9
Imperial	IMPR	Holtville		7									7
Riverside	COAV	Mecca			4		3						7
Riverside	COAV	Mecca				2	4			2			8
Riverside	COAV	Oasis					1						1
			6	**21**	**4**	**12**	**16**		**7**	**3**	**1**		**70**

*In some flocks when a chicken seroconverted, it was replaced by a non-infected chicken.

Table 17. West Nile virus surveillance detections, by county, California, 2003.

	Imperial	Los Angeles	Orange	Riverside	San Bernardino	San Diego	**California**
Humans	1	1	0	1	0	0	**3**
Horses	0	0	0	0	0	1	**1**
Birds	0	65	3	13	10	5	**96**
Sentinel chickens	54	0	0	16	0	0	**70**
Mosquito pools	16	6	0	10	0	0	**32**

Source: California Department of Health Services

Table 18. Dead birds reported and tested for West Nile virus (WNV), 2003.

	American crow			Other species			
County	**Reported**	**Tested**	**WNV (+)**	**Reported**	**Tested**	**WNV (+)**	
Alameda	48	14		179	17		
Alpine	0	0		4	0		
Amador	3	0		23	4		
Butte	33	7		206	23		
Calaveras	0	0		15	2		
Colusa	2	1		9	1		
Contra Costa	60	4		396	50		
Del Norte	0	0		3	1		
El Dorado	3	0		141	13		
Fresno	42	7		138	14		
Glenn	3	3		6	1		
Humboldt	6	2		15	3		
Imperial	2	0		26	8		
Inyo	14	3		58	7		
Kern	9	2		61	11		
Kings	8	2		12	0		
Lake	7	2		13	1		
Lassen	1	0		1	0		
Los Angeles	778	196	62	838	149	3	(raven, sparrow, scrub jay)
Madera	15	0		16	1		
Marin	35	9		64	6		
Mariposa	3	1		6	0		
Mendocino	9	0		24	5		
Merced	37	6		121	15		
Mono	1	0		10	2		
Monterey	27	9		27	3		
Napa	8	4		22	2		
Nevada	4	1		72	2		
Orange*	223	65	2	187	54	1	(Northern flicker)
Placer	16	3		134	16		
Plumas	0	0		10	0		
Riverside	203	77	9	403	109	4	(blackbird, house finch, sparrow, scrub jay)
Sacramento	163	35		594	90		
San Benito	2	2		11	0		
San Bernardino	209	58	9	401	63	1	(sparrow)
San Diego	128	62	2	369	195	3	(house finch, mockingbird, sparrow)
San Francisco	7	1		43	4		
San Joaquin	50	8		103	13		
San Luis Obispo	24	5		145	11		
San Mateo	17	6		132	20		
Santa Barbara	28	8		52	7		
Santa Clara	57	17		166	24		
Santa Cruz	3	0		51	2		
Shasta	10	4		51	5		
Sierra	0	0		2	0		
Siskiyou	0	0		8	0		
Solano	9	0		82	5		
Sonoma	48	6		112	12		
Stanislaus	35	8		129	21		
Sutter	17	5		52	14		
Tehema	5	0		12	1		
Trinity	0	0		7	0		
Tulare	14	2		39	7		
Tuolumne	0	0		11	1		
Ventura	42	8		95	24		
Yolo	90	30		147	34		
Yuba	5	0		33	9		
TOTAL	**2563**	**683**	**84**	**6087**	**1082**		**12**

* Note: Orange County tested with VecTest.

Source: California Department of Health Services

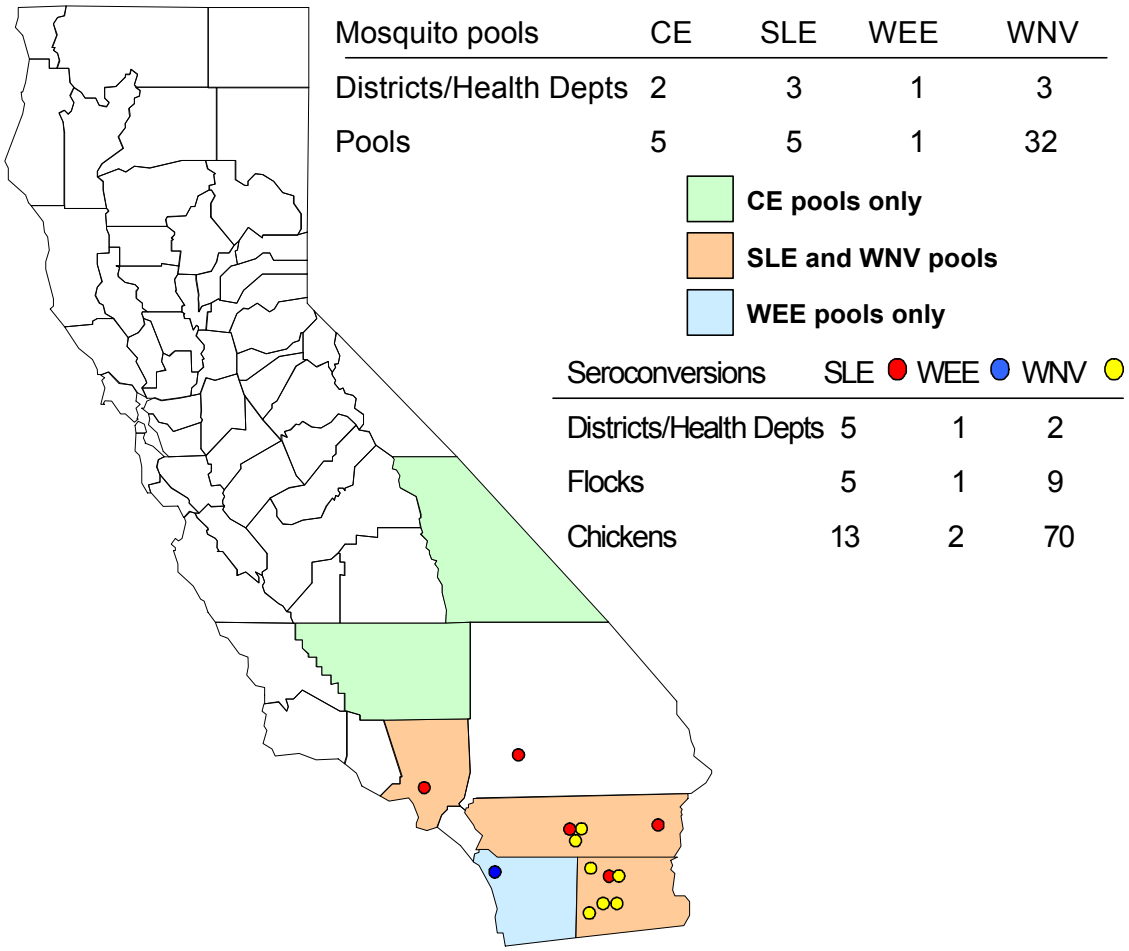

Figure 3. Collection site of mosquito pools positive for SLE, WEE, WNV, or CE, and location of sentinel chicken flocks with one or more seroconversions to SLE, WEE, or WNV, California, 2003.

Source: California Department of Health Services

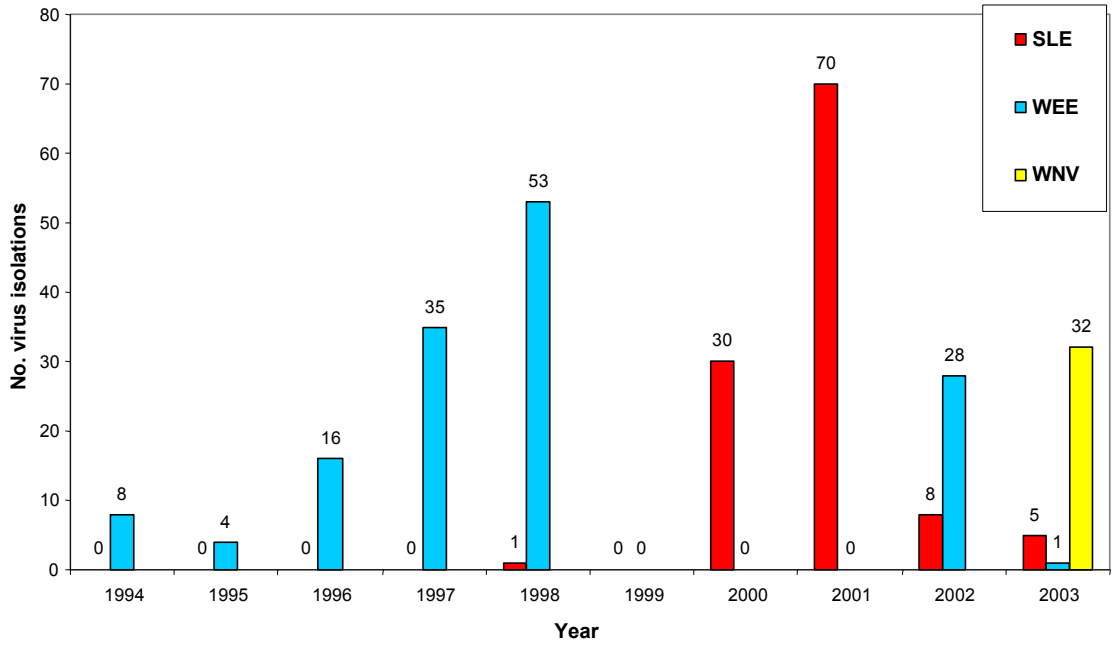

Figure 4. Isolations of SLE, WEE, and West Nile viruses from pooled mosquitoes in California, 1994-2003.

Source: California Department of Health Services

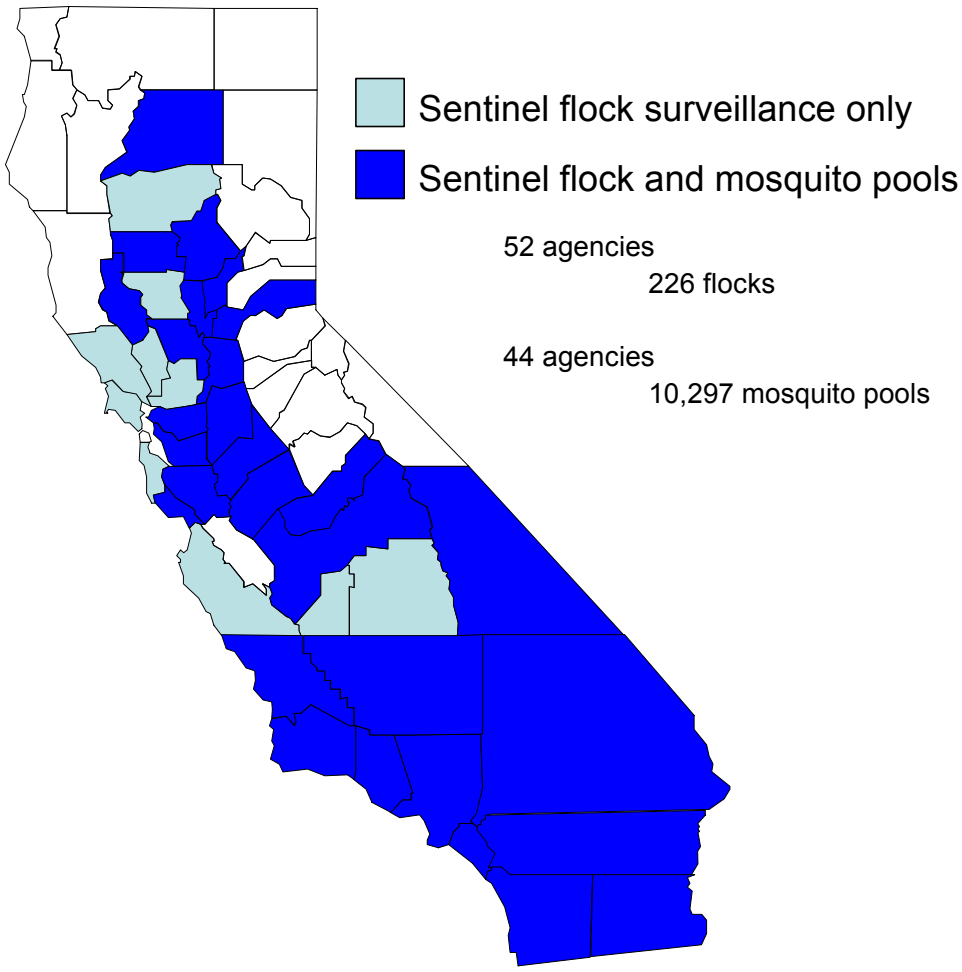

Figure 5. Counties from which chicken sera +/- mosquito pools were submitted for testing for CE, SLE, WEE, and West Nile viruses, California, 2003.

Source: California Department of Health Services

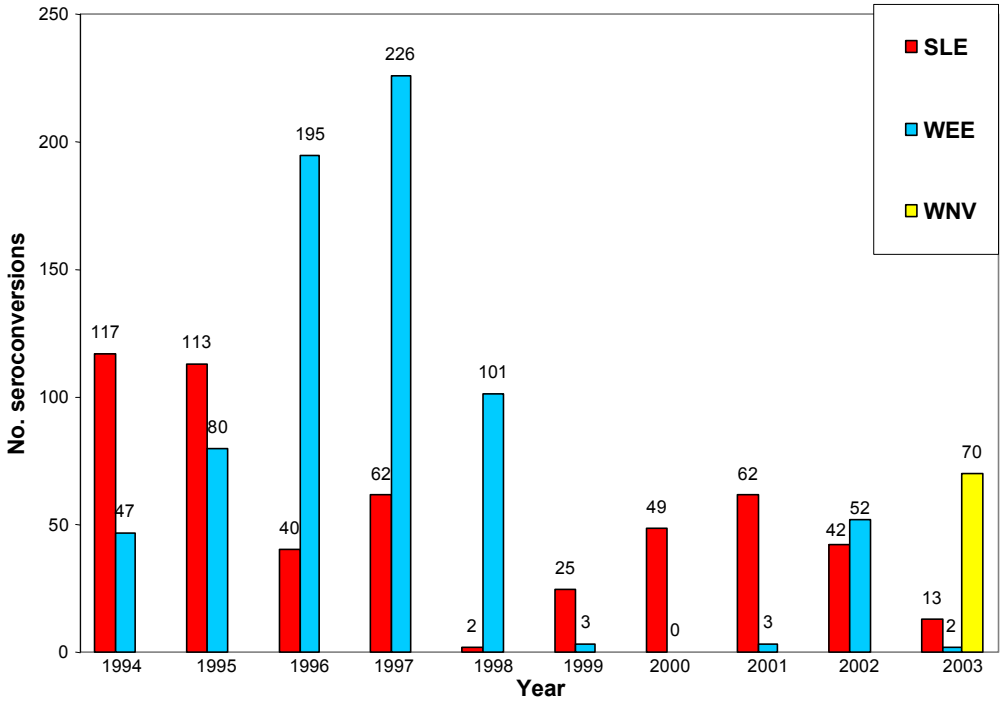

Figure 6. Seroconversions to SLE, WEE, and West Nile viruses in sentinel chickens, California, 1994-2003.

Source: California Department of Health Services

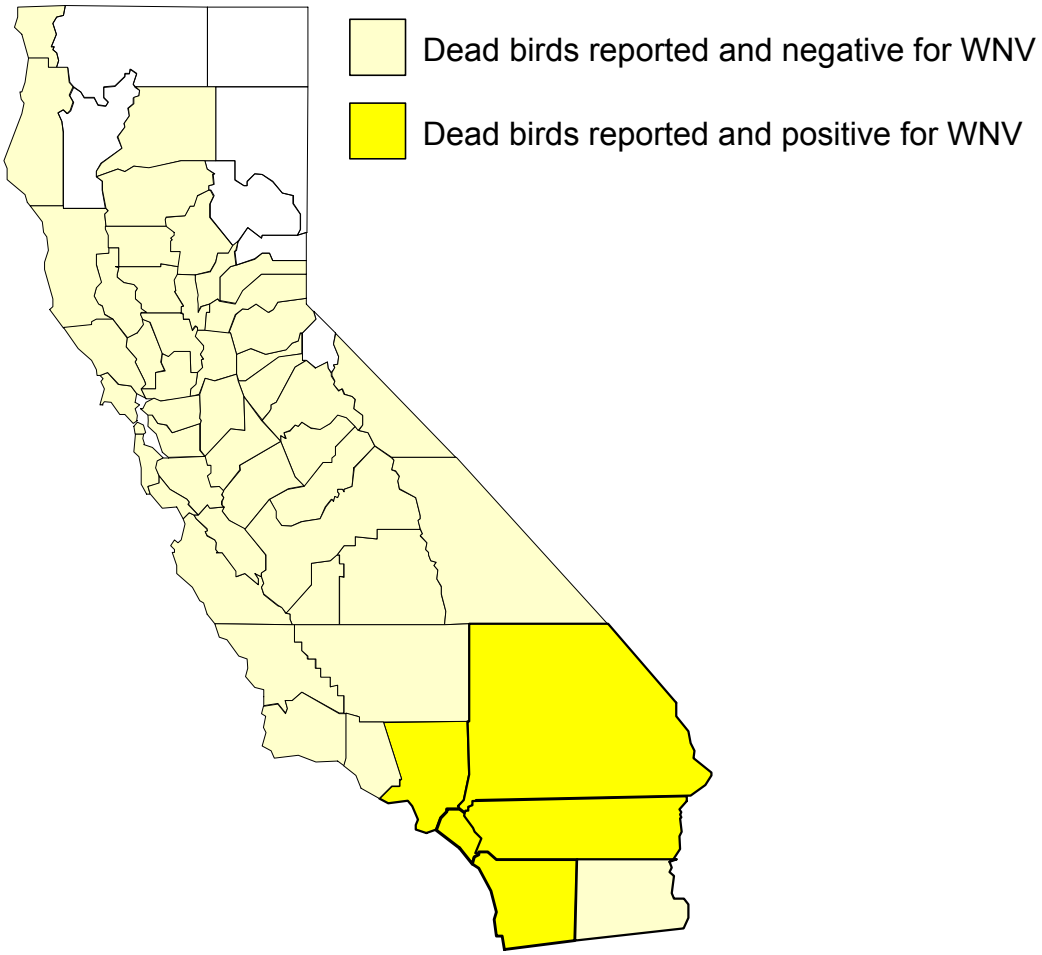

Figure 7. State map of dead birds reported and tested for West Nile virus by county, 2003.

Source: California Department of Health Services

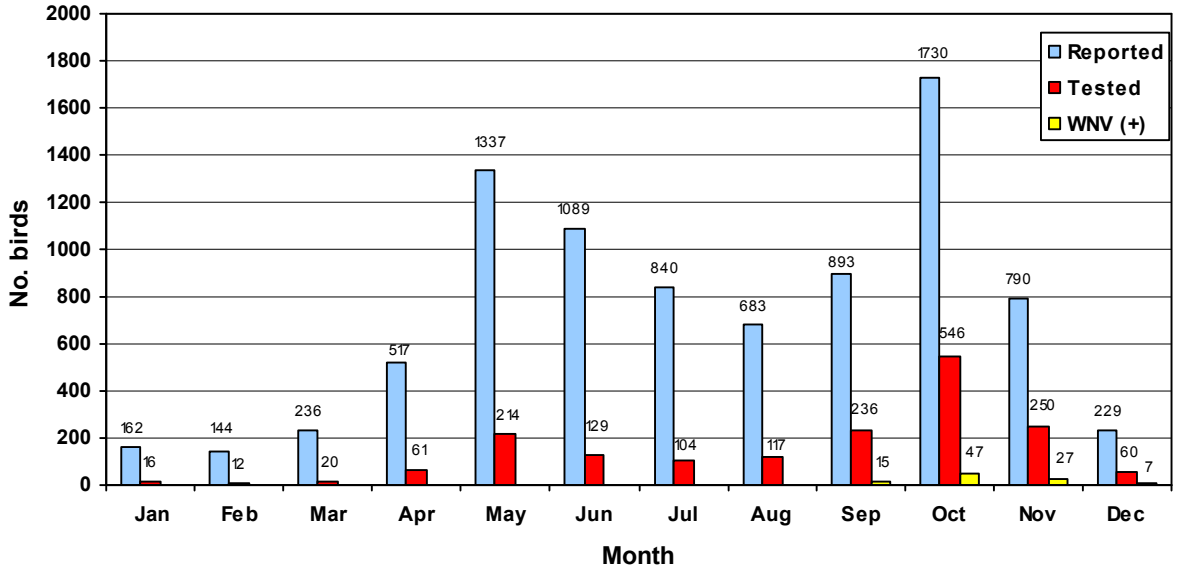

Figure 8. Dead wild birds reported to the CDHS West Nile virus (WNV) Hotline and tested for WNV, California, 2003.

Source: California Department of Health Services

Caltrans Special Project: Mosquito Production

Introduction and background
In 1997, the California Department of Transportation (Caltrans) initiated a Best Management Practice (BMP) Retrofit Pilot Program for treating stormwater runoff from selected facilities in Los Angeles and San Diego Counties. The objective of this program was to evaluate the installation and operation, as well as relative benefits and costs, of various structural "treatment" BMP devices for improving water quality. Caltrans retrofit 39 BMPs at 33 strategically selected study sites (e.g., freeway interchanges, "park and rides", and maintenance stations) using eight different designs.

Concern was raised that treatment BMP installations, such as those implemented by Caltrans, could potentially impact public health by increasing habitat availability for aquatic stages of disease vectors, particularly mosquitoes. The California Department of Health Services (CDHS) entered into a Memorandum of Understanding with Caltrans in 1999 to provide technical expertise regarding vector production and the potential of vector-borne diseases within its stormwater BMP Retrofit Pilot Program. It was the intent of this agreement to document and, where possible, mitigate vector production and harborage at the BMP pilot project sites. The CDHS Vector-Borne Disease Section (VBDS) established a comprehensive vector surveillance and monitoring program, developed vector abatement protocols, and recommended design modifications to reduce or eliminate the potential of BMPs to produce or harbor vectors. VBDS also identified which BMPs were least conducive to vector production.

Project activities: 1999-2002
The initial surveillance and monitoring study, conducted by VBDS and collaborating local vector control agencies in 1999-2001, revealed that mosquitoes were the dominant vector species observed within BMP structures. Eight mosquito species were collected from standing water in BMPs, including four that are known vectors of human disease such as viral encephalitis and malaria. Of the eight different types of BMPs in the study, those that maintained permanent sources of standing water in sumps or basins provided excellent habitat for immature mosquitoes.

In June 2001, Caltrans extended VBDS funding for the BMP/vector special project for an additional two years. VBDS responsibilities were expanded to include many additional BMP sites in San Diego, Orange, Los Angeles, Siskiyou, and Shasta Counties. Many of the original BMP Retrofit Pilot Program sites were decommissioned by Caltrans shortly after the completion of the initial two-year study. However, collaborating local vector control agencies continued to monitor a few selected BMPs of "special concern" due to their tendency to harbor and breed mosquitoes.

Project activities: 2003
In 2003, Caltrans extended VBDS funding for the BMP/vector special project for a third consecutive term, ending in June 2007. The agreement called for an expansion of the size and scope of research projects beginning in 2004. Caltrans funding for local vector control agencies previously working with VBDS were also renewed to provide continued monitoring of selected BMPs known to be highly conducive to mosquito production.

<u>Mosquito surveillance</u>
Local vector control agencies provided VBDS with weekly inspection data collected from Caltrans BMPs. Mosquito surveillance in Los Angeles County found no mosquitoes breeding

in monitored BMPs. This indicated that BMP mosquito-proofing retrofits installed by Caltrans engineers in 2001 and 2002 continued to be successful. In contrast, mosquitoes were regularly collected from BMPs in San Diego County. In particular, mosquito presence and abundance data clearly demonstrated the propensity of below-ground BMPs to harbor adult mosquitoes and to provide excellent year-round breeding habitats for *Culex quinquefasciatus*. The number of mosquito species detected in southern California Caltrans BMPs increased from eight to nine in 2003 with the collection of *Culiseta particeps* in San Diego County in November. This finding further underscores the diversity of habitats created by different stormwater BMPs (particularly as they degrade and age) that are suitable for mosquito species with widely divergent habitat preferences.

In June 2003, VBDS initiated a BMP vector surveillance study in the city of South Lake Tahoe and surrounding areas. Water treatment and quality are of special concern in this area due to political and regulatory pressure to remove fine sediments and nutrients from runoff before it is discharged into Lake Tahoe. In response to these concerns, numerous BMPs have been installed and more are planned in the South Lake Tahoe area. Because certain BMP designs and locations may be particularly suitable for mosquito production, this study is intended to help direct placement of future additional BMPs in the Tahoe Basin such that they will pose a minimal public health risk. Also, by identifying those BMPs that pose the greatest likelihood of mosquito production, surveillance and control activities of local mosquito control districts can be more efficiently targeted.

VBDS's project will document and compare mosquito production in 15 BMPs and 15 natural mosquito breeding sources located throughout South Lake Tahoe. Mosquitoes known to breed in the Tahoe Basin include *Culex tarsalis*, *Culiseta inornata*, *Cs. incidens*, *Cs. impatiens*, *Ochlerontatus tahoensis*, *Oc. hexondontus*, *Oc. increpitus*, and *Oc. ventrovittis*, some of which can transmit disease to humans and are known pest species. In 2003, preliminary environmental data that might influence mosquito habitat quality, such as temperature, precipitation, elevation, and slope (eastern vs. western), were documented. Geo-locating reference coordinates for all 30 study sites were determined to facilitate spatial analysis and to more efficiently target resources for the surveillance and control of mosquitoes and other vectors of human disease. Monitoring for and collection of immature stage mosquitoes will begin in April 2004.

Review and design recommendations for mosquito suppression

In 2003, VBDS provided expert consultation and recommendations during the preconstruction phase of BMP plan reviews. This proactive approach was intended to help identify potential vector breeding habitats prior to construction. Plans for stormwater treatment BMPs as well as "litter BMPs" (trash-removing devices) were sent to VBDS for review and comment. These included plans for both new construction and retrofit improvements to existing sites. VBDS made recommendations on certain BMP designs, or specific features within a design, to reduce their potential to create new vector breeding sites. VBDS encouraged stormwater engineers to consider vectors when siting, designing, and installing new BMP devices. Because there are many variables that can favor vector production, VBDS strongly encouraged Caltrans to have all BMPs, both new and retrofit, monitored regularly to ensure that they do not create threats to public health.

Education and outreach

In 2003, VBDS continued to conduct extensive education and outreach to the stormwater and vector control communities. The goal of these activities was to raise awareness of the

potential public health impacts created by certain BMP devices and the long-term implications associated with their construction.

VBDS co-authored a letter to the editor of *Stormwater* magazine and authored a paper for the Proceedings of the 2nd Annual StormCon Conference. VBDS gave four presentations on public health concerns associated with existing and anticipated BMPs. In addition, VBDS participated in meetings of the Los Angeles County Department of Public Works BMP Task Force and the California Storm Water Quality Association.

Summary of VBDS activities in 2003

- Regularly inspected Caltrans BMPs for areas of standing water as well as for design and maintenance flaws that had the potential to create vector breeding habitats.
- Provided Caltrans with comments and recommendations for preventing vector breeding habitats in BMPs based on field observations and/or engineering plans.
- Continued collaboration with local vector control agencies conducting vector surveillance at selected BMP sites.
- Initiated a study in South Lake Tahoe to evaluate mosquito production in urban BMPs compared with naturally occurring breeding sites.
- Maintained a database on immature mosquito abundance data in BMPs that were monitored by collaborating vector control agencies.
- Presented seminars on issues pertaining to BMP devices and vector production at professional meetings, continuing education seminars, and informal meetings.
- Prepared several publications on BMPs and vectors in an effort to educate both the stormwater and vector control communities.

United States Forest Service Activities

In 1992, the Vector-Borne Disease Section (VBDS) of the California Department of Health Services entered into a Challenge Cost-Share Agreement with the Pacific Southwest Region of the United States Department of Agriculture Forest Service to maintain cooperative surveillance and control of vector-borne diseases within the National Forests. The United States Forest Service (USFS) and VBDS established this agreement to achieve mutually beneficial objectives in pest control and management, mandated by both federal and state law. VBDS and USFS agreed to work cooperatively in planning and implementing vector-borne disease management programs.

In accordance with this agreement, VBDS staff conducted field activities in the following National Forests in 2003: Angeles, Cleveland, Eldorado, Inyo, Klamath, Lake Tahoe Basin Management, Lassen, Los Padres, Mendocino, Modoc, Plumas, San Bernardino, Sequoia, Shasta-Trinity, Sierra, Six Rivers, Stanislaus, and Tahoe. In addition, VBDS provided consultation, certification, and oversight to autonomous agencies (environmental health departments and vector control agencies) concerning vector-borne diseases and pesticide applications for public health purposes on USFS land.

Activities conducted by VBDS staff in National Forests included disease surveillance, risk assessment, risk reduction, and education of USFS personnel and concessionaires. Direct surveillance included the collection and testing of indicator species and vectors for plague, hantavirus, Lyme borrelioses, relapsing fever, and other tick-borne diseases (Table 19); indirect surveillance included visual assessment of vector-borne disease risk factors (e.g., counting active rodents and evaluating rodent burrows for abandonment). Based on surveillance information, risk reduction recommendations for vector-borne diseases were made for recreational areas, fire stations, fire lookouts, employee residences, and work places. Recommendations included control of vectors, rodent management, and habitat modification. Vector suppression actions involving pesticides included training on pesticide safety for USFS personnel or other groups who participated in the control effort. Follow-up evaluations were made to determine whether vector numbers had been adequately reduced. Educational activities involved providing information on specimen collection and identification, vector-borne disease epidemiology, and methods to reduce risk of infection. Posters and brochures produced by VBDS staff on plague, hantavirus, and Lyme disease were distributed to ranger district offices, USFS concessionaires, USFS fire stations, and individual campgrounds in regions endemic for these diseases. This Annual Report includes detailed information on vector-borne disease activities in individual National Forests during 2003.

Table 19. Laboratory testing of specimens collected on USFS lands, 2003.

National Forest	Hantavirus Surveillance (Rodents)		Plague Surveillance (Rodents)		Plague Surveillance (Carnivores)[1]		*Borrelia* Surveillance (*Ixodes* Ticks)[2]		Other Pathogen Surveillance (Other Ticks)[3]	
	Positive	**Tested**	**Positive**	**Tested**	**Positive**	**Tested**	**Positive**	**Tested**	**Positive**	**Tested**
Angeles	0	31	0	171[4]	0	31				
Cleveland	0	30			0	35	0	33		
Eldorado	45	94			2	15				
Inyo			2	39					3	35
Klamath					0	17				
Lassen			6	38						
Los Padres			0	80	0	140	0	42		
Mendocino					0	5				
Modoc					12	40				
Plumas	30	421	0	7	3	10				
San Bernardino	2	54	0	257			2	106[5]		
Sequoia					7	44				
Shasta-Trinity					0	6	8	651		
Sierra					0	9				
Six Rivers					0	3				
Stanislaus					0	7				
Tahoe	0	15			0	10				
Total, All Forests:	**77**	**645**	**8**	**592**	**24**	**372**	**10**	**832**	**3**	**35**

[1]Carnivore specimens taken directly from or immediately adjacent to USFS lands. Because of the broad home range of carnivores, results obtained can be inferred to a large area, including both USFS and adjacent lands. Many of these specimens were collected by United States Department of Agriculture, Animal Wildlife Services, through a contractual agreement with DHS.

[2]*Ixodes pacificus* ticks tested for infection with *Borrelia* spp. Ticks were tested in collaboration with the United States Army Center for Health Promotion and Preventive Medicine (USACHPPM), the University of California, and the Washoe County (Nevada) Vector Control Laboratory.

[3]*Ornithodoros hermsi* ticks tested for infection with *Borrelia hermsii* in collaboration with University of California, Irviine. Some test results are pending.

[4]Testing conducted by the Los Angeles County Department of Health Services.

[5]Two pools of *I. pacificus* ticks were positive for a *Borrelia* species belonging to relapsing fever group.

Source: California Department of Health Services

ACTIVITY SUMMARY BY INDIVIDUAL NATIONAL FORESTS

Angeles National Forest

- Conducted plague surveillance in collaboration with Los Angeles County Department of Health Services (LACDHS). Serum antibody to *Yersinia pestis*, the bacterial agent of plague, was detected in none of 171 rodents trapped and tested.
- Conducted visual survey of ground squirrel activities (plague risk assessment) at Table Mountain, Lake, and Mountain Oak Campgrounds. A total of 25 California ground squirrels and 2 chipmunks was observed at Table Mountain Campground (113 camp sites) and 1 California ground squirrel and 2 western gray squirrels were observed at the Lake Campground. No ground squirrel was observed at the Mountain Oak Campground. At the time, the risk of plague transmission appeared to be minimal at these sites.
- Los Angeles County Agriculture Commissioner's office, in collaboration with LACDHS, applied approximately 550 pounds of Deltamethrin to squirrel burrows at 57 campgrounds covering 63 acres to control fleas and reduce the risk of plague transmission.

Cleveland National Forest

- Conducted a tick survey in collaboration with personnel from the Northwest Mosquito and Vector Control District. A total of 33 *Ixodes pacificus* adults was collected; none was positive for *Borrelia burgdorferi* infection.
- Conducted plague surveillance in collaboration with personnel from the San Diego County Department of Environmental Health-Vector Surveillance and Control Program (SDDEH-VSCP) at Fry Creek and Observatory Campgrounds on Mount Palomar. Antibodies to *Y. pestis* were detected in four of 14 ground squirrels trapped. As a result, SDDEH-VSCP applied approximately seven pounds of Deltamethrin to squirrel burrows at these two campgrounds covering about six acres to control fleas and reduce the risk of plague.
- Conducted a visual survey of ground squirrel activities (plague risk assessment) at El Cariso and Upper San Juan Campgrounds. One California ground squirrel was observed at El Cariso Campground and no ground squirrel was observed at Upper San Juan Campground.
- Provided technical consultation to personnel from Cottonwood Fire Station on control of yellow jackets and honey bees.
- Discussed the use of pesticides for rodent flea control (plague control/prevention) with personnel from the SDDEH-VSCP and the Cleveland National Forest .

Eldorado National Forest

- Conducted a tick survey in April in the Grizzly Flat area (in and around Seventh Day Adventist Youth Camp). A single *I. pacificus* adult was collected in four person-hours of flagging.
- Conducted hantavirus surveillance in June, August, and September at Lumberyard Fire Station and Leek Springs Fire Lookout. Antibody to Sin Nombre virus (SNV) was detected in 18 of 29, 2 of 8, and 11 of 24 deer mice captured at Lumberyard site during the respective months. At Leek Springs, antibody to SNV was detected in 6 of 17, 11 of 24, and 2 of 8 deer mice captured during the respective months.

- Conducted a visual survey of ground squirrel activities (plague risk assessment) in July in the Union Valley Reservoir area. Normal rodent populations were observed (i.e., no unusual activity). Laminated plague caution posters were provided to the concessionaire.
- Conducted a visual survey of ground squirrel activities (plague risk assessment) in September at the following recreation sites: Wrights Lake, Ice House, Strawberry Point, Northwind, Silver Lake, Lumberyard, South Shore, Pardoes Point, Sugar Pine Point, Fashoda, and Gerle Creek. Risk of plague transmission at most of these sites was deemed to be low. Campgrounds were posted with plague caution posters and vector-borne disease issues were discussed with campground hosts. Dense populations of California ground squirrels were noted at Strawberry Point, Northwind, and Ice House Campgrounds. This observation was conveyed to USFS personnel at the Pacific Ranger District.
- Provided educational brochures on plague, hantavirus, Lyme disease, and West Nile virus to the Pioneer Ranger District.

Inyo National Forest

- Organized and conducted an extensive survey to determine the transmission risk of relapsing fever at the Crestview Fire Station, in collaboration with Inyo and Mono County Departments of Environmental Health. A total of 158 *Ornithodoros hermsi* soft ticks (36 adults, 103 nymphs, and 19 larvae) was collected from the station. *Borrelia hermsii*, the causative bacteria of tick-borne relapsing fever, were detected in three tick pools through testing conducted at the University of California, Irvine.
- Conducted a field investigation at a site near Bishop where a person may have contracted Lyme disease. It was determined that the risk of exposure to *B. burgdorferi*-infected ticks at the site was minimal.
- Conducted a rodent survey (*Peromyscus* spp.) at an unimproved campsite along a creek west of Bishop. Over 50 trap–nights, six *Peromyscus* spp. were captured, three of which were *P. maniculatus*.
- Conducted plague surveillance at Crestview Fire Station. Fifteen chipmunks and five golden-mantled ground squirrels were trapped. Two of the chipmunks tested positive for antibody to *Y. pestis*.
- Conducted plague surveillance at Four Jeffery Campground. Nine California ground squirrels, two Belding ground squirrels, and eight chipmunks were trapped. Serum antibodies to *Y. pestis* were detected in none of the rodents collected.
- Conducted a visual survey of ground squirrel activities (plague risk assessment) at Pine Glen, Shady Rest, Old Shady Rest, and Big Springs Campgrounds. Two golden-mantled ground squirrels at Pine Glen, three golden-mantled ground squirrels and one chipmunk at Shady Rest Campground, three golden-mantled ground squirrels at Old Shady Rest Campground, and thirteen golden-mantled ground squirrels at Big Springs Campground were observed. The risk for plague transmission at these sites was considered low.
- Conducted a visual survey of ground squirrel activities (plague risk assessment) at French Camp, East Fork, and Shady Rest Campgrounds. Rodent activity was minimal at all three campgrounds.
- A total of 20 rodent bait stations was placed around the Crestview Fire Station, covering approximately five acres, in an effort to control ectoparasites on rodents. About 2.5 pounds of diazinon 2D were added to each rodent bait station (total of 7.5 pounds administered) three times in 2003.
- Visited USFS White Mountain Ranger Station in Lone Pine and provided educational materials.

- Gave a presentation on hantavirus and other vector-borne diseases at the Inyo National Forest Employee Responsibility Training Meeting in Bishop. Approximately 200 employees attended.
- Gave a presentation on plague and tick-borne diseases in Inyo National Forest at an Inyo National Forest Concessionaires meeting in Bishop.
- Gave a presentation on plague and tick-borne relapsing fever to Inyo National Forest Service personnel at the Forest Service Visitor Center in Mammoth Lakes.

Klamath National Forest

- Conducted a tick survey at O'Neil Creek, Sarah Totten, and Portuguese Creek recreation sites. No *Ixodes* adult ticks were collected.
- Conducted a visual survey of ground squirrel activities (plague risk assessment at Juanita Lake and Martin's Dairy Campgrounds. Over 20 golden-mantled ground squirrels and at least 10 chipmunks were observed during the Juanita Lake survey. Plague and hantavirus awareness as well as yellow jacket control issues were also discussed with the campground host. Vector-borne disease issues were discussed with the Goosenest Ranger Station office. Brochures, including West Nile virus information, were provided to the recreation officer.
- Gave a presentation on Lyme disease at a Happy Camp Ranger District meeting held in Happy Camp. Sixty employees attended. Brochures on Lyme disease, hantavirus, plague, and West Nile virus were provided.

Lake Tahoe Basin Management

- Conducted a visual survey of ground squirrel activities (plague risk assessment) at the following campgrounds in September: Bayview, Camp Richardson Resort, Fallen Leaf, Kaspian, Meeks Bay, William Kent, and the Tallac visitor center. Fallen Leaf Campground had above normal populations of golden-mantled ground squirrels and California ground squirrels on the northern border. Plague caution signs were posted at campgrounds and vector-borne disease issues were discussed with campground hosts.
- Discussed the potential for zoonotic disease safety training of USFS and concessionaire personnel with the unit's district ranger and supervising recreational officer.

Lassen National Forest

- Conducted a visual inspection of the Bogard Fire Station, Eagle Lake Ranger District, for rodent activity and potential hantavirus risk. Shop buildings, mess hall, living quarters, and storage buildings were inspected for rodent activity, rodent access, contamination sites, and safety measures. Snap traps were in use in most facilities. Evidence of continued mice activity was noted in the mess hall and fire cache despite USFS staff attempts at control. Recommendations and brochures were provided to staff.
- Conducted a visual survey of ground squirrel activities (plague risk assessment) at the following campgrounds: Battle Creek, Merrill, Christie, Benner Creek, and Almanor. Plague caution posters were in place at all campgrounds and no rodent carcasses were reported by campground hosts. Brochures on vector-borne diseases were provided to concessionaire area supervisors at Eagle Lake and Battle Creek regions.
- Conducted plague surveillance at Crater Lake Campground, Eagle Lake Ranger District. A total of 15 chipmunks and 4 golden-mantled ground squirrels was trapped. Antibody to *Y. pestis* was detected in serum from 5 of 12 Shadow chipmunks and 1 of 3 Lodgepole

chipmunks. The rodent flea index was low with an average of 0.25 fleas/ground squirrel and 0.80 fleas/chipmunk. Plague caution posters were replaced with plague warning signs. In addition, signs were posted throughout the campground that instructed campers to report sick or dead rodents to USFS staff. Few rodent burrows were noted in campsites during evaluation. The Eagle Lake Ranger District's Resource Officer and the Chico State Foundation concessionaire participated in the continued evaluation of plague risk at this recreation site.

- A visual assessment was conducted in August at Crater Lake Campground following detection of *Y. pestis* antibodies in rodents collected at the site during an evaluation in July. The 17-unit campground was inspected for rodent activity. Rodents, including juveniles, were abundant. No dead rodents were discovered and few rodent burrows were noted within developed sites. The campground was well posted with plague warning posters as well as USFS/Concessionaire posters that instructed visitors to report sick or dead rodents to staff. Due to the extremely low number of fleas per animal collected during the initial evaluation, no control measures were implemented. The site will be re-evaluated in 2004.
- Conducted plague surveillance at Merrill Campground, Eagle Lake Ranger District, in August following collection of two rodent carcasses (one golden-mantled ground squirrel and one yellow pine chipmunk); both carcasses were culture-negative for *Y. pestis*. Rodents were abundant at the 180-unit campground. Ten golden-mantled ground squirrels were sampled and had a high flea index, averaging 16 fleas per animal. No blood samples were taken from these squirrels. Twenty yellow-pine chipmunks were also sampled and had an average of 3.5 fleas per animal. Antibodies to *Y. pestis* were not detected in serum samples from 20 yellow pine chipmunks and 1 pine squirrel. Additional plague caution posters and brochures were provided to the concessionaire (Chico State Foundation) supervisor and to the Eagle Lake Ranger District Resource Officer. USFS staff were trained in rodent surveillance techniques used during plague evaluations.
- Plague posters and vector-borne disease brochures were provided to the Eagle Lake and Almanor Ranger Stations.
- Plague posters and vector-borne disease brochures were provided to the Hat Creek Ranger District office in Fall River.
- Discussed rodent-borne diseases and provided brochures to the Old Station Fire Station, as follow-up to hantavirus risk evaluation conducted in 2002.
- Discussed rodent-borne disease issues with, and provided educational brochures to, the recreation concessionaire, Chico State Foundation. All campgrounds in Hat Creek District were posted with plague caution signs.
- Gave safety presentation to Lassen Forest Engineering Division at a regional training session held in Susanville. Topics covered were hantavirus awareness, risk reduction, and clean-up of contaminated areas.

Los Padres National Forest

- Conducted plague surveillance at Chuchupate Campground. Thirty-nine rodents were trapped; flea numbers were low and antibodies to *Y. pestis* were not detected in serum specimens.
- Conducted plague surveillance at Davy Brown Campground (4 California ground squirrels), Upper Oso Campground (18 California ground squirrels); Arroyo Seco Campground (16 California ground squirrels, 3 brush mice and 2 meadow voles). Antibodies to *Y. pestis* were not detected in serum specimens.
- Conducted visual surveys of ground squirrel activities (plague risk assessment) at Valle Vista, Mt. Pinos, McGill, Reyes Creek, Aliso Park, and Wheeler Gorge Campgrounds, and

Mil Potrero Park. Signs of increased rodent activity were observed at Mil Potrero Park, Mt. Pinos, and Reyes Creek.
- Conducted a visual survey of ground squirrel activities (plague risk assessment) at Chuchupate, Cachuma, Nira, Figueroa, Paradise, and Fremont Campgrounds. Chipmunks were abundant at Chuchupate Campground.
- Conducted a special study on the effectiveness of lufenuron in feed cubes to control rodent fleas at Chuchupate Campground in May, June, July, and early September.
- Investigated a report of dead and sick animals at Cold Springs Trail (Santa Barbara District.), a remote trail and small hike-in campground. The risk of plague transmission to humans at the site appeared minimal.
- Analyzed 20 years of flea data and flea control efforts at Chuchupate Campground and conducted statistical analysis of the last six years of flea control efforts (pre- and post-treatment comparisons). Related manuscripts are in preparation.
- Gave a presentation on "Safety Hazards in the Los Padres" at Santa Barbara District Volunteer training. Approximately 60 people attended.
- Provided annual update on plague status at Chuchupate Campground to District Ranger.
- Provided technical advice to District Ranger on yellow jacket control and bat exclusion at Arroyo Seco Campground.
- Provided a report to the District Ranger on noxious plant problem at Reyes Creek Campground.

Mendocino National Forest

- Conducted a visual survey of ground squirrel activities (plague risk assessment) at Oak Flat, Pogie Point, Fuller Grove, and Sunset Campgrounds around Lake Pillsbury. Numerous ground squirrels were observed at Oak Flat Campground, which was normal for this site. Few to moderate numbers of ground squirrels were noted at the other three campgrounds.
- Assessed risk of plague transmission at each campground and findings were documented on the DHS Plague Risk Assessment Form. Risk was considered "moderate" for Oak Flat Campground and "low" for the other three campgrounds.

Modoc National Forest

- Conducted a visual survey of ground squirrel activities (plague risk assessment) at Lower Rush Creek Campground, Big Valley Ranger District, and Mill Creek and Blue Lake Campgrounds, Warner Mountain Ranger District, in May. Few rodents were noted, plague caution posters were in place, and campgrounds were open for use.
- Conducted a visual survey of ground squirrel activities (plague risk assessment) at six campgrounds at Medicine Lake, Doublehead Ranger District. Medicine Lake, Hemlock, and Headquarters Campgrounds support numerous golden-mantled ground squirrels. Campgrounds at Group Camp, Bullseye Lake, and Paynes Spring support abundant chipmunk populations. Plague caution signs were posted at all campgrounds and no signs of rodent die-off were observed.
- Provided plague posters and brochures on vector-borne diseases to the Cedarville Ranger Station.
- Discussed vector-borne disease issues, including West Nile virus, and provided educational brochures provided to the Big Valley Ranger District office in Adin. Plague caution signs were posted at campgrounds within the district.

Plumas National Forest

- Continued a multi-year hantavirus risk study at Laufman Fire Station, Beckwourth Ranger District. Two nights of rodent collection were conducted in April, May, June, July, August, and October. A total of 535 rodents was collected over approximately 2,100 trap-nights. Serum specimens were collected from a total of 368 rodents. Antibodies to SNV were detected in 28 specimens: 18 *Peromyscus maniculatus*, 5 *P. boylii*, 2 *P. crinitus*, and 2 *Reithrodontomys megalotis*. Twenty-two percent of all serum specimens and 29 percent of the positive sera came from rodents captured in and around structures at the facility. Results were provided to station staff. Rodent exclusion and control efforts were made following VBDS recommendations. One structure was cleaned and decontaminated for future use by station personnel.
- In April and October, an additional 16 and 40 rodent sera, respectively, were collected from areas adjacent to the Laufman facility (approximately one kilometer from the study area). Antibodies to SNV were detected in none of these specimens.
- Conducted a visual inspection of a vacant building at the Laufman facility previously condemned due to rodent infestation and associated hantavirus risk. A recovery plan and room-by-room safety clean-up recommendations were discussed with the province safety officer. Thorough cleaning and sanitization of this structure prior to reoccupancy by staff was emphasized. Respiratory protection and other safety measures for staff involved in the clean-up were discussed.
- Provided expert guidance to the province safety officer on a written protocol for employee hantavirus awareness, associated safety issues, and clean-up guidelines for use in the Plumas, Lassen, and Modoc National Forests.
- Provided hantavirus safety and clean-up guidelines for decontamination and recovery of a formerly occupied office building at the Laufman Fire Station. All work was conducted and supervised by USFS staff in October. Following clean-up, VBDS staff inspected the building and rodent control and exclusion recommendations were initiated.
- Conducted a walk-through hantavirus risk inspection at Thompson Peak Lookout. The facility and storage area were inspected. Employee safety was discussed and several rodent access points to the building were identified in need of repair. Provided brochures on hantavirus and plague and answered employees' questions.
- Responded to a request for hantavirus/plague evaluation at the Thompson Peak lookout, Beckwourth Ranger District, in October. Rodent exclusion and control was requested by staff working at the facility and was accomplished in August by USFS personnel. No further rodent activity was noted either in the occupied work space or the storage area below. Nine mice and six chipmunks were captured during overnight deployment of 90 Sherman live traps. Antibodies to SNV were detected in sera from two mice.
- Conducted visual survey of ground squirrel activity (plague risk assessment) in June at Chilcoot Campground. Few signs of rodent actitivy were noted in a visual survey of campsites.
- Conducted visual survey of rodent activity (plague risk assessment) in August at Lone Rock, Long Point, and Boulder Creek Campgrounds, Mt. Hough Ranger District. Golden-mantled ground squirrels were active, but few chipmunks were observed. Plague caution signs were posted at the campgrounds.
- Conducted visual survey of ground squirrel activities (plague risk assessment) in August at Lakes Basin Campground, Beckwourth Ranger District. Very few rodents were observed. Plague caution signs were posted at the campgrounds.
- Discussed vector-borne disease issues with, and provided educational brochures and plague caution posters to, Mohawk Ranger Station and Beckwourth Ranger District.

- Discussed plague with, and provided educational brochures and plague posters to, recreation staff of the Mount Hough Ranger District.

San Bernardino National Forest

- Conducted tick-borne disease surveillance at areas near San Jacinto Mountains, in collaboration with Riverside County Department of Environmental Health Vector Control Program. A total of 183 *I. pacificus* adult ticks was collected. Of 89 ticks tested to date for presence of *Borrelia* spp., a *B*. *miyamotoi*-like spirochete was identified in two *I. pacificus* collected at Thomas Mountain.
- Conducted tick survey at Lytle Creek and Sevaine Canyon Creek areas, in collaboration with San Bernardino County Vector Control Program. One *Dermacentor* sp. and 15 *I. pacificus* were collected at Lytle Creek and 14 *Dermacentor* sp. and 2 *I. pacificus* were collected at Sevaine Canyon Creek. *B*. *burgdorferi* was detected in none of the *I*. *pacificus* ticks.
- Conducted a hantavirus survey near the City Creek Forest Service Facility, in collaboration with personnel from San Bernardino County Vector Control Program. One harvest mouse, three brush mice, one deer mouse, two California mice, and one dusky-footed woodrat were trapped. None was positive for SNV.
- Conducted plague surveillance at Stone Creek, Boulder Basin, Dark Canyon, Fern Basin, and Marion Mountain Campgrounds in collaboration with Riverside County Department of Environmental Health, Vector Control Program. Antibody to *Y. pestis* was detected in none of 130 serum specimens collected from trapped rodents
- Conducted plague surveillance at Serrano Group, Fawnskin, Meadow's Edge, Apple White, Forest Falls, Hart Bar, and San Gorgonio Campgrounds, in collaboration with San Bernardino County Vector Control Program. Antibody to *Y. pestis* was detected in none of 127 serum specimens collected from trapped rodents.
- Conducted visual surveys of ground squirrel activities (plague risk assessment) at Apple White Campground on four different occasions. A total of 11, 22, 8, and 6 California ground squirrels (42 camp sites) was observed during each of the four surveys. The risk for plague transmission at the site appeared to be low.
- Conducted visual survey of ground squirrel activities (plague risk assessment) along the foothills in Rancho Cucamonga. Signs of rodent activity were not observed.

Sequoia National Forest

- Conducted visual survey of ground squirrel activities (plague risk assessment) at Pioneer Point, Boulder Gulch, Tillie, Headquarters, Camp 9, and Paradise Cove Campgrounds. Although low numbers of California ground squirrels were observed at each of these campgrounds, the potential for plague transmission appeared to be low.
- Conducted meeting with the district biologists from the Tule River and Hot Springs Ranger Districts. Information and brochures on vector-borne diseases possibly found in the National Forests were provided.

Shasta-Trinity National Forest

- Conducted tick-borne disease surveillance in January at Pine Point Campground on Lake Shasta. *B. burgdorferi* was detected in none of 69 adult *I. pacificus* ticks collected and tested. Tick activity was assessed within camp sites to determine whether tick control measures might be necessary to protect visitors.

- Conducted tick-borne disease surveillance in February at Gregory Creek Campground, Hirtz Bay Campground, and at Packers Bay recreation site on Lake Shasta. Sixty *I. pacificus* adult ticks were collected at Gregory Creek, 150 ticks were collected at Hirtz Bay, and 65 ticks were collected at Packers Bay. In addition, over 120 *I. pacificus* ticks were collected from Mary Smith, 85 from Cooper Gulch, 40 from Ackerman, and 25 from Tunnel Rock Campgrounds. *B. burgdorferi* was detected in none of the ticks.
- Conducted tick-borne disease surveillance in March at the following recreation sites around Lake Shasta (number of *I. pacificus* ticks collected): Moore Creek Campground (100), McCloud Bridge Campground (40), Bailey Cove Campground (50), and Dekkas Rock (90). (These ticks were not tested for *B. burgdorferi*.) Ticks were also collected at the following recreation sites in the Trinity Lake area: Rush Creek Campground (22), Stoney Creek Swim Area (80), Stoney Point Campground (50), Minersville Campground (40), and Eagle Creek Campground (5). Additional ticks were collected along the Trinity River at Pigeon Point Campground (32) and along the Helena Road leading to Hobo Gulch Campground (45). *B. burgdorferi* was detected in none of these ticks.
- Conducted tick-borne disease surveillance in April at recreation sites around Lake Shasta, Shasta Lake Ranger District. *Ixodes pacificus* ticks were collected from Hirz Bay Campground (10), Dekkas Rock (15), Pine Point Campground (75), and Gregory Creek Campground (5). Data was used in compiling a risk assessment for these sites.
- Conducted tick surveillance in May at recreation sites around Lake Shasta, Lake Shasta Ranger District, and Lewiston and Trinity Lakes, Weaverville Ranger District. *I. pacificus* ticks were collected at Hirz Bay (30) and Nelson Point (45) at Lake Shasta, and from Mary Smith (85) and Cooper Gulch (55) Campgrounds at Lewiston Lake. Sixty ticks were also collected from the Stoney Creek recreation sites at Trinity Lake.
- Conducted tick surveillance at Basin Gulch Campground, Yolla-Bolla Ranger District, and surrounding area in early June. No *Ixodes* ticks were collected.
- Conducted tick surveillance at Hobo Gulch Campground and Helena Road area, Big Bar Ranger District in June. No *Ixodes* ticks were collected.
- Conducted tick surveillance in December at Hirz Bay Campground, Dekkas Rock, and Moore Creek Campground. Thirty-seven *I. pacificus* adult ticks were collected from the Hirz Bay site. Tick warning posters were provided to the Hirz Bay Campground concessionaire for placement on the public bulletin board.
- Collected and tested for *B. burgdorferi I. pacificus* ticks from Hirz Bay (5 infected of 48 tested), Packers Bay Fish Loop Trail (2 of 35), and Moore Creek Campground (2 of 75). Pine Point Campground ticks tested negative (0 of 69). McCloud Bridge, Nelson Point, Gregory Creek, and Bailey Cove Campgrounds were sampled monthly from January through April for adult tick activity, but ticks collected from these sites were not tested. Maps of adult tick distribution were compiled for Pine Point, Gregory Creek, Moore Creek, and Hirz Bay Campgrounds. Lyme disease information and tick warning posters were provided to the recreation staff at Shasta Lake Ranger District.
- Provided educational brochures on vector-borne diseases to the McCloud Ranger Station and Ash Creek Fire Station. Cattle Camp and Fowlers Campgrounds were visually surveyed for ground squirrel activities (plague risk assessment); golden-mantled ground squirrel activity was noted.
- Conducted tick collection at Basin Gulch Campground in the Yolla Bolla Ranger District. Thirty-five adult *I. pacificus* ticks were collected from campsites but none of them was tested for *B. burgdorferi*.
- Provided Lyme disease and hantavirus brochures to Shasta Lake Visitor Center at Mountain Gate in February. Discussed Lyme disease transmission potential in lake area with staff. Brochures and tick warning signs were provided to Shasta Lake Ranger Station.

Lyme disease surveillance at Shasta Lake recreation sites was discussed with the Assistant Recreation Officer who provided site maps for tick locations within each campground.
- Provided vector-borne disease brochures and Lyme disease information to Hodge Management employees and to the recreation concessionaires at Lewiston and Trinity Lakes. Brochures on vector-borne diseases were provided to the Big Bar Ranger Station.
- Discussed Lyme disease surveillance activities at Lewiston and Trinity Lake recreation sites with Assistant Recreation Officer from the Weaverville Ranger District. On-site field training in tick ecology was provided at Mary Smith Campground. Information and brochures on Lyme disease and hantavirus were provided for staff use and awareness.
- Brochures for Lyme disease, hantavirus, and plague were provided to officers at Harrison Gulch (Yolla Bolla) Ranger Station. Tick activity at Basin Gulch Campground was also discussed. Safety presentations regarding vector-borne disease issues were offered for future consideration.

Sierra National Forest

- Conducted visual survey of ground squirrel activities (plague risk assessment) in July at Upper Chiquito Campground and Jackass Lakes Trailhead. No unusual rodent activity was noted. Plague caution signs were posted at both locations.
- Provided educational brochures, caution posters, and annual reports to Minarets Ranger Information Center, Minarets Work Center, Clover Meadow Station, and Bass Lake Station in July.

Six Rivers National Forest

- Conducted tick survey in May at Big Flat Campground, Gasquet Ranger District. Five *I. pacificus* adult ticks were collected but not submitted for testing. Ticks positive for *B. burgdorferi* had been previously collected at this site in March 2000. The risk of tick bites for visitors to the campground was judged to be low.
- Provided information and brochures on Lyme disease, hantavirus, and West Nile virus to the Lower Trinity and Gasquet Ranger Stations.

Stanislaus National Forest

- Conducted visual survey of ground squirrel activities (plague risk assessment) in July at Baker, Deadman, Eureka Valley, Pigeon Flat, Dardenelles, Brightman Flat, Bloomfield, Hermit Valley, Pacific Valley, Mosquito Lake, and Boulder Flat Campgrounds. No unusual rodent activity was noted at these locations. Educational brochures were provided to, and vector-borne disease prevention measures were discussed with, campground hosts.
- Visited Mi Wok and Summit Ranger District Offices and Brightman and Bear Valley Forest Service Stations in July. Educational brochures were supplied to staff at each location.
- Delivered educational materials to supervisor's office in Sonora in December. Also met with Safety Officer to discuss VBDS services, including vector-borne disease prevention training. As a follow-up, vector-borne disease educational materials were delivered.
- Visited with staff at Hathaway Pines Ranger District and Dorrington Fire Station in late May and provided vector-borne disease educational brochures. Campgrounds along Highway 4 were not surveyed as they were still closed due to snow.

Tahoe National Forest

- Discussed hantavirus concerns associated with a storage building and shop utilized by staff of the Sierraville Ranger Station in January. Heath and safety information was provided as well as clean-up recommendations. Following initial contacts, VBDS staff conducted a survey at the Ranger Station to evaluate hantavirus exposure risk. Sixty-five Sherman live-traps were set overnight in facility buildings and outdoor sites of likely rodent harborage, including a storage barn and boneyard. Fifteen rodents, including 13 *P. maniculatus*, were collected; serum antibodies to SNV were detected in none of the rodents. Consultation on rodent control and exclusion, risk reduction protocols, and disease awareness was provided to facility management.
- In response to detection of *Y. pestis* antibodies in a chipmunk carcass, plague surveillance was conducted at Kidd Lake Campground. Three yellow-pine chipmunks and four golden-mantled ground squirrels were trapped and tested. Antibodies to *Y. pestis* were detected in none of the rodents. Flea counts on the rodents were low. Plague warning signs were posted.
- Conducted visual survey of ground squirrel activities (plague risk assessment) at Cold Creek, Cottonwood, Lower Little Truckee, Prosser, Upper Little Truckee, and Lakeside Campgrounds. Normal rodent populations were observed at these sites. Plague caution signs were posted.
- Conducted visual survey of ground squirrel activities (plague risk assessment) at campgrounds in the Lakes Basin region, Downieville Ranger District. No unusual rodent activity was noted at the Salmon Creek, Sardine Lake, Diablo, Berger Creek, Pack Saddle, Packers Lake day-use, Sierra, and Yuba Pass Campgrounds. These campgrounds are dominated by chipmunk activity, which may go unnoticed. Plague caution signs and vector-borne disease brochures were provided to the concessionaires.
- Conducted visual survey of ground squirrel activities (plague risk assessment) at Goose Meadows, Granite Flat, and Silver Creek Campgrounds. Normal rodent populations were observed. Plague caution signs were posted and vector-borne disease issues were discussed with campground hosts.
- Provided educational brochures on plague and hantavirus to the Truckee Ranger District.

OTHER SERVICES PROVIDED:

- Sent out a pre-season letter to all USFS Forest Supervisors, District Offices, and campground concessionaires via an electronic mail distribution list. This letter described the services that VBDS staff can provide to the USFS and included contact information for VBDS biologists.
- Provided training in vector-borne disease epidemiology and vector control to USFS personnel, county environmental health departments, and vector control districts that work on USFS lands. Training is provided through annual workshops, special seminars and presentations, and field hands-on training.
- Updated a by-Forest contact list of USFS biologists, district rangers, fire management officers, recreation officers, and safety officers. This contact list will assist VBDS biologists to communicate investigation and surveillance findings to appropriate USFS personnel and will also help to ensure that all areas of the USFS in California receive service by VBDS.
- Updated a contact list for USFS Region 5 campground concessionaire companies. This contact list will enable VBDS biologists to contact campground hosts to discuss vector-borne diseases. This contact list will also assist VBDS in the investigation of human disease cases where the site of infection was thought to be a USFS campground.

- Provided USFS report to the California Department of Health Services Vector Control Advisory Committee during its annual meeting in Sacramento.
- Continued the multi-agency tick surveillance study to better understand the ecology of *I. pacificus* ticks and tick-borne disease transmission risks in southern California. Some of the sites selected are within San Bernardino National Forest. This research project, which was initiated in 2001, is being conducted in collaboration with the LACDHS, Riverside County EHD, and Los Angeles West Vector Control District.
- Organized and moderated a Tick Symposium at 71st Annual Conference of the Mosquito and Vector Control Association of California. Some of the presentations provided information collected in National Forests.
- Published "A regional-based study to evaluate Lyme disease transmission risk in southern California" in the Proceedings and Papers of the 71st Annual Conference of the Mosquito and Vector Control Association of California. Some of the data included in the paper were derived from San Bernardino National Forest.
- Published "Ecological conditions associated with tick-borne relapsing fever in Inyo and Mono Counties, California, 2000-2002" in the Proceedings and Papers of the 71st Annual Conference of the Mosquito and Vector Control Association of California. The data presented in the paper were collected in Inyo National Forest.

Vector Control Technician Certification Program

The California Department of Health Services (CDHS) administers the Public Health Vector Control Technician certification examination in May and November each year. The purpose of this examination is to certify the competence of government agency personnel in the control of vectors for the health and safety of the public. Authority to administer this exam is found in Health and Safety Code, Section 106925, which requires every government agency employee who handles, applies, or supervises the use of any pesticide for public health purposes to be certified by the CDHS. Standards governing certification of local agency vector control personnel are found in Title 17 of the California Code of Regulations, Sections 30001-30061. The first CDHS-sponsored certification examination to qualify agency personnel in mosquito control was held in April 1974.

To become certified in a control category, applicants must pass the Core section and at least one Specialty section of the examination. Applicants to the examination pay a fee for each section requested on their applications. The Core section consists of questions relating to the safe and effective use of pesticides. Specialty sections contain questions relating to the control of relevant vectors of the other exam sections listed in Table 20. Successful examinees are issued a gold certification card, which is valid for two years in the qualified categories specified on the card. To maintain their full certification status in subsequent two-year cycles, Certified Technicians are required to pay annual renewal fees and meet minimum continuing education requirements. Successful examinees electing not to participate in continuing education are issued parchment certificates in the categories in which they qualified. These Certified Technicians (Limited) employees may not use pesticides except under the direct supervision of a Certified Technician.

Through 2003, 1,137 Vector Control Technicians employed at 106 local public health agencies held 2,458 certificates (Table 21). The agencies include 54 Mosquito Abatement Districts, Mosquito and/or Vector Control Districts and other special districts, 38 departments of county government, 13 departments of city government, and the Vector-Borne Disease Section. Table 22 compares the certification status among employees of Mosquito and Vector Control Association of California (MVCAC) corporate member agencies and non-MVCAC member agencies.

Table 20. Results of certification examinations administered in 2003.

Exam section	No. exams given	No. passed (%)
Core	89	58 (65.2)
Mosquito Control	101	60 (59.4)
Terrestrial Invertebrate Vector Control	78	31 (39.7)
Vertebrate Vector Control	64	40 (62.5)
Totals	332	189 (56.9)

Table 21. Vector Control Technician certificates in effect as of December 2003.

	No. certificates		
Certification category	**Full status**	**Limited status**	**Total**
Mosquito Control	664	193	857
Terrestrial Invertebrate Vector Control	528	214	742
Vertebrate Vector Control	540	319	859
Totals	1732	726	2458

Table 22. Certification status among MVCAC corporate member agencies and non-MVCAC agencies.

	Certified Technicians		Certified Technicians (Limited)	
Agency Type	**No. Agencies**	**No. Employees**	**No. Agencies**	**No. Employees**
MVCAC	53	602	16	98
Non-MVCAC	23	92	33	343
Totals	76	694	49	441

Source: California Department of Health Services

Staff Presentations and Publications

Presentations
JANUARY

- **Distribution of the western black-legged tick, *Ixodes pacificus*, in Los Angeles County**
  Richard Davis: 71st Annual Conference Mosquito and Vector Control Association of California (MVCAC), Palm Springs
- **Safety hazards of wild animal diseases in the Los Padres National Forest**
  Richard Davis: Los Padres National Forest Volunteers Safety Training Session, Santa Barbara
- **Exposure to rodent-borne viruses among persons with elevated occupational risk**
  Curtis Fritz: MVCAC Annual Conference, Palm Springs
- **West Nile virus preparedness for San Francisco**
  Albert Hom: The San Francisco IPM Conference, San Francisco
- **Evaluation of factors related to transmission risk of Lyme disease in southern California**
  Renjie Hu: MVCAC Annual Conference, Palm Springs
- **Ecology and seasonal distribution of Lyme disease ticks in San Bernardino County**
  Renjie Hu: MVCAC Annual Conference, Palm Springs
- **Tick-borne disease surveillance in California: An overview**
  Lucia Hui: MVCAC Annual Conference, Palm Springs
- **Summary of mosquito-borne encephalitis virus surveillance in California: 1998-2002**
  Lucia Hui: MVCAC Annual Conference, Palm Springs
- **Testing for human pathogens in ticks**
  Anne Kjemtrup: MVCAC Annual Conference, Palm Springs
- **An assessment of West Nile virus preparedness in California**
  Vicki Kramer: MVCAC Annual Conference, Palm Springs
- **Surveillance for mosquito-borne encephalitis virus activity and human disease in California, 2002**
  Vicki Kramer: MVCAC Annual Conference, Palm Springs
- **West Nile virus preparedness in California**
  Vicki Kramer: Pesticide Enforcement and Regulatory Committee Workshop, Sacramento
- **California's mosquito-borne virus surveillance and response plan**
  Vicki Kramer: United States Fish and Wildlife Service Mosquito Control Workshop, Davis
- **West Nile virus: An overview and update**
  Vicki Kramer: Northern California Parasitologists Meeting, Davis
- **Mosquitoes and urban stormwater systems**
  Marco Metzger: Santa Ana Watershed Project Authority, Treatment Wetlands and Improved Water Quality Workshop, Riverside
- **West Nile virus update**
  Mark Novak: Mutual Aid Regional Advisory Committee (IV) meeting, Sacramento
- **West Nile virus: When is it coming, where is it going?**
  Mark Novak: Audubon Society, Sacramento Chapter meeting, Sacramento
- **Update on vector-borne diseases in California**
  Mark Novak: Merced College Pest Management Class, Merced

- **Success in the Sink**
  Ken Townzen: MVCAC Annual Conference, Palm Springs
- **West Nile virus—Are we prepared?**
  Jim Tucker: Pesticide Applicators Professional Association (PAPA) Continuing Education Workshop, Yuba City
- **Investigation and management of epizootic plague in the Truckee-Donner area, California**
  Jim Tucker: MVCAC Annual Conference, Palm Springs
- **Epidemiologic investigation of tick-borne relapsing fever cases in Inyo and Mono Counties**
  Todd Walker: MVCAC Annual Conference, Palm Springs

FEBRUARY

- **Wild rodents**
  Richard Davis: DHS/MVCAC Vertebrates of Public Health Importance in California Workshop, Santa Fe Springs and Vacaville
- **Bats**
  Richard Davis: DHS/MVCAC Vertebrates of Public Health Importance in California Workshop, Santa Fe Springs
- **Overview of vertebrates of public health importance**
  Curtis Fritz: DHS/MVCAC Vertebrates of Public Health Importance in California Workshop, Santa Fe Springs and Vacaville
- **Vector-borne diseases and West Nile virus**
  Albert Hom: PAPA Seminar, Salinas
- **Bats, insects, and rodents**
  Renjie Hu: Etiwanda School District, Rancho Cucamonga
- **Snakes and lizards**
  Marco Metzger: DHS/MVCAC Vertebrates of Public Health Importance in California Workshop, Santa Fe Springs and Vacaville
- **Update on vector-borne diseases, including West Nile virus**
  Mark Novak: PAPA Workshop, Stockton
- **Vector-borne diseases in California**
  Jim Tucker: Shasta College, Redding
- **Commensal rodent control**
  Jim Tucker: DHS/MVCAC Vertebrates of Public Health Importance in California Workshop, Santa Fe Springs and Vacaville
- **Carnivores and opossums**
  Todd Walker: DHS/MVCAC Vertebrates of Public Health Importance in California Workshop, Santa Fe Springs and Vacaville

MARCH

- **The Black Death: A danse macabre with plague through the ages**
  Curtis Fritz: Epidemiology & Control of Infectious Diseases, School of Public Health, University of California, Berkeley
- **Hantavirus pulmonary syndrome**
  Curtis Fritz: Epidemiology & Control of Infectious Diseases, School of Public Health, University of California, Berkeley

- **West Nile virus update**
  Albert Hom: PAPA Continuing Education Workshop, Sacramento
- **West Nile virus update**
  Albert Hom: Fresno Environmental Health Department, Fresno
- **West Nile virus preparedness in California**
  Lucia Hui: City Managers of San Mateo County, Foster City
- **Vector ecology models to forecast vector-borne diseases**
  Ken Linthicum: Department of Biology Seminar Series, University of California, Los Angeles
- **Worker safety and vector-borne diseases in California**
  Jim Tucker: PAPA Continuing Education Workshop, Sacramento
- **West Nile virus update**
  Todd Walker: PAPA Vertebrate Pest Control Workshops, Ontario

APRIL

- **West Nile surveillance in California**
  Marty Castro: California Environmental Health Association 52nd Annual Symposium, Napa
- **Yellowjackets and Africanized honey bees**
  Marty Castro: Pesticide Applicators Seminar, Sonoma County Parks, Santa Rosa
- **Rodent and vector-borne diseases surveillance in California**
  Lucia Hui: Virology Seminar, Department of Plant and Microbial Biology, University of California, Berkeley
- **West Nile virus preparedness in California**
  Vicki Kramer: Department of Pesticide Regulation Workshop, Sacramento
- **Adulticiding: Drop size and weather**
  Ken Townzen: MVCAC Sacramento Valley Region Continuing Education, Yuba City
- **West Nile virus—California or bust!**
  Jim Tucker: West Nile virus Emergency Response Committee Meeting, Placer County

MAY

- **Ticks in California and Sonoma County with field identification**
  Marty Castro: Marin/Sonoma Mosquito and Vector Control District Continuing Education Workshop, Cotati
- **West Nile virus preparedness and update**
  Albert Hom: Fresno Office of Emergency Preparedness, Fresno
- **Vector-borne diseases surveillance in California**
  Lucia Hui: Medical Entomology Seminar, Department of Environmental Science, Policy, and Management, University of California, Berkeley
- **Tick-borne disease update in California**
  Lucia Hui: Lyme Disease Resource Center Annual Conference, Ukiah
- **California's West Nile virus surveillance and response plan**
  Vicki Kramer: Pesticide Regulatory Education Program, United States Environmental Protection Agency, Davis
- **The Cooperative agreement between California Department of Health Services and local vector control agencies**
  Todd Walker: MVCAC Southern Region Continuing Education Workshop, San Bernardino

- **Plague and tick-borne relapsing fever**
  Todd Walker: U.S. Forest Service, Inyo National Forest, Forest Service Visitor Center, Mammoth Lakes

JUNE

- **West Nile virus and ticks and tick-borne diseases update**
  Richard Davis: PAPA Workshop, Santa Maria
- **Hantavirus and more**
  Renjie Hu: Inyo National Forest Employee Responsibility Training, Bishop
- **Plague and tick-borne diseases in Inyo National Forest**
  Renjie Hu: Inyo National Forest concessionaires meeting, Bishop
- **Dead bird surveillance program in California**
  Lucia Hui: Animal Control and Wildlife Refugee of Alameda County, Fremont
- **West Nile virus: An update**
  Vicki Kramer: Sacramento Association of Realtors, Sacramento
- **Predicting animal disease outbreaks with remote sensing and GIS technologies**
  Ken Linthicum: US Department of Agriculture Ministerial Conference and Expo on Agricultural Science and Technology, Sacramento

JULY

- **Bugs, rats, and bats and West Nile virus**
  Marty Castro: Lake County Department of Health Services, Lakeport
- **Vector-borne diseases and West Nile virus update**
  Albert Hom: San Francisco Department of Environment, San Francisco
- **West Nile virus**
  Ken Linthicum: Mutual Aid Regional Advisory Committee, Mutual Aid Regions I and VI, Simi Valley
- **Disease vectors associated with stormwater treatment devices.**
  Marco Metzger: Los Angeles County Department of Public Works, Special Workshop for Plan-Checkers and BMP Designers, Alhambra
- **Mosquitoes and urban stormwater systems**
  Marco Metzger: Second Annual North American Surface Water Quality Conference & Exposition (StormCon), San Antonio, Texas
- **West Nile virus—California or bust!**
  Jim Tucker: West Nile virus Emergency Response Committee Meeting, Nevada County

AUGUST

- **Flea identification of common flea species in the coastal regions**
  Albert Hom: San Mateo MAD, San Mateo
- **West Nile virus surveillance and preparedness in California**
  Vicki Kramer: California Department of Health Services, Sacramento

SEPTEMBER

- **Responsibilities of CDHS/VBDS under the cost share agreement with USFS**
  Renjie Hu: Cleveland National Forest, San Diego

- **West Nile virus activity in California and the United States**
  Vicki Kramer: Statewide Emergency Planning Committee, Sacramento
- **New public health strategies to reduce the risk of globalization of hemorrhagic fevers**
  Ken Linthicum: Department of Entomology Seminar Series, University of California, Riverside
- **National and state West Nile virus update**
  Mark Novak: Regional Environmental Health Directors' Meeting, South Lake Tahoe

OCTOBER

- **Biology of the California ground squirrel**
  Richard Davis: Southern San Joaquin MVCAC Continuing Education Symposium, Visalia
- **Looking for hantavirus in California**
  Lucia Hui: Virology, Department of Plant and Microbial Biology, University of California, Berkeley
- **West Nile virus preparedness in California**
  Ken Linthicum: California Medical and Health Disaster Conference, Oakland, Commerce, and Temecula
- **Implications of global climate change on the risk of vector-borne disease transmission**
  Ken Linthicum: Department of Biology, California State University, San Bernardino
- **West Nile virus: When is it coming, where is it going?**
  Mark Novak: MVCAC Northern San Joaquin Valley Regional Continuing Education, Modesto
- **West Nile virus surveillance program and procedures: A to Z**
  Mark Novak: MVCAC Northern San Joaquin Valley Regional CE, Modesto
- **Pesticide resistance in mosquitoes**
  Ken Townzen: MVCAC Northern San Joaquin Valley Region Continuing Education, Modesto
- **West Nile virus—Are we prepared?**
  Jim Tucker: Amador County Environmental Health, Jackson

NOVEMBER

- **Worker safety protections from vector-borne diseases**
  Richard Davis: PAPA Workshop, Oxnard
- **Tick-borne relapsing fever: A pedantic review**
  Curtis Fritz: Microbial Diseases Laboratory Seminar, California Department of Health Services, Richmond
- **Tales of an itinerant epidemiologist**
  Curtis Fritz: Veterinary Epidemiology class, School of Veterinary Medicine, University of California, Davis.
- **West Nile virus: When is it coming, where is it going?**
  Mark Novak: Audubon Society, San Joaquin Chapter meeting, Stockton
- **Update on vector-borne diseases in California**
  Mark Novak: University of California Cooperative Extension Workshop, Mariposa
- **Targeting *Culex tarsalis* by aircraft**
  Ken Townzen: MVCAC Sacramento Valley Region Continuing Education, Willows
- **Current status of West Nile virus in the U.S. and California**
  Jim Tucker: MVCAC Sacramento Valley Region Workshop, Willows

DECEMBER

- **West Nile virus update: 2003**
  Albert Hom: Coastal Region MVCAC Continuing Education Workshop, San Ramon
- **Public health threats from arboviruses**
  Vicki Kramer: Epidemiology and Preventive Medicine 290 seminar, University of California, Davis
- **Current status of West Nile virus in the U.S. and California**
  Jim Tucker: PAPA Continuing Education Workshop, Sacramento

Publications

Barker CM, Reisen WK, **Kramer VL**. California state mosquito-borne virus surveillance and response plan: A retrospective evaluation using conditional simulations. *American Journal of Tropical Medicine and Hygiene* 2003; 68:508-518.

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